図1 Fig. 1

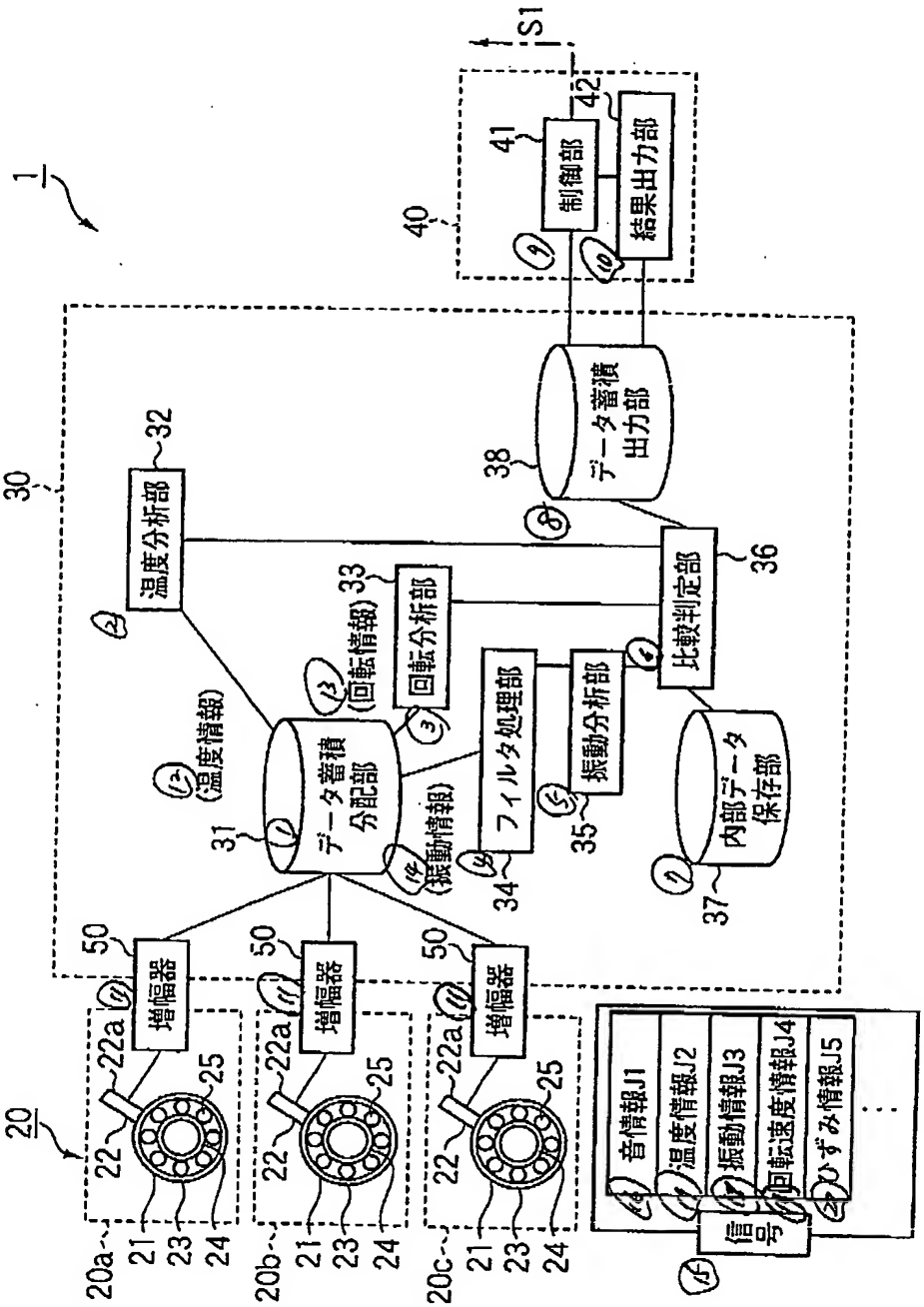

1
S1
40
41
制御部
42
結果出力部
30
38
データ蓄積
出力部
温度分析部
32
回転分析部
33
比較判定部
36
(温度情報)
(回転情報)
データ蓄積
分配部
31
フィルタ処理部
34
振動分析部
35
(振動情報)
内部データ
保存部
37
増幅器
50
22a
22
25
20
21
23
24
20a
20b
20c
音情報J1
温度情報J2
振動情報J3
回転速度情報J4
ひずみ情報J5
信号

Fig.2(a)
図2(a)

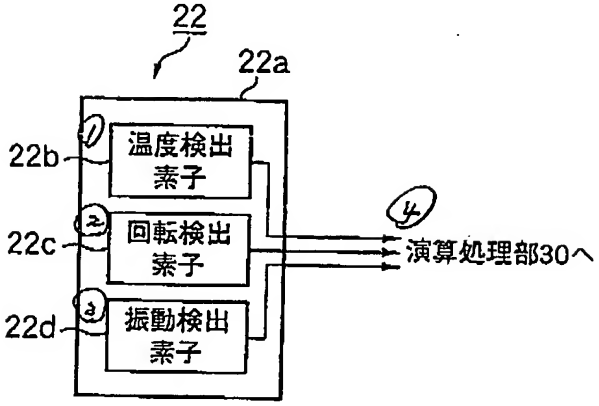


Fig.2(b)
図2(b)

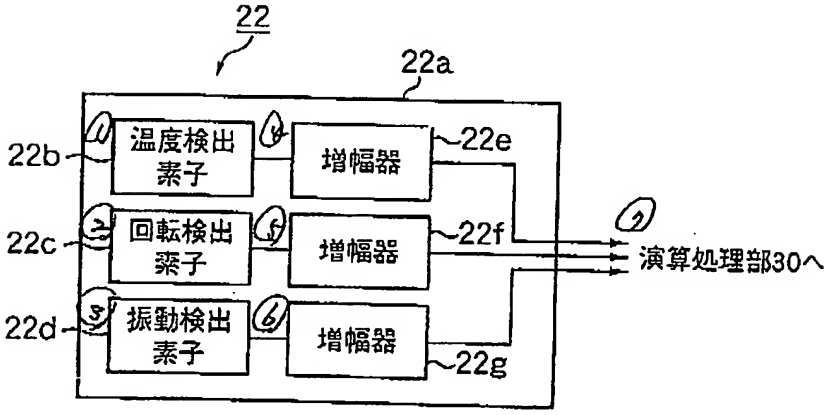


図3 Fig.3

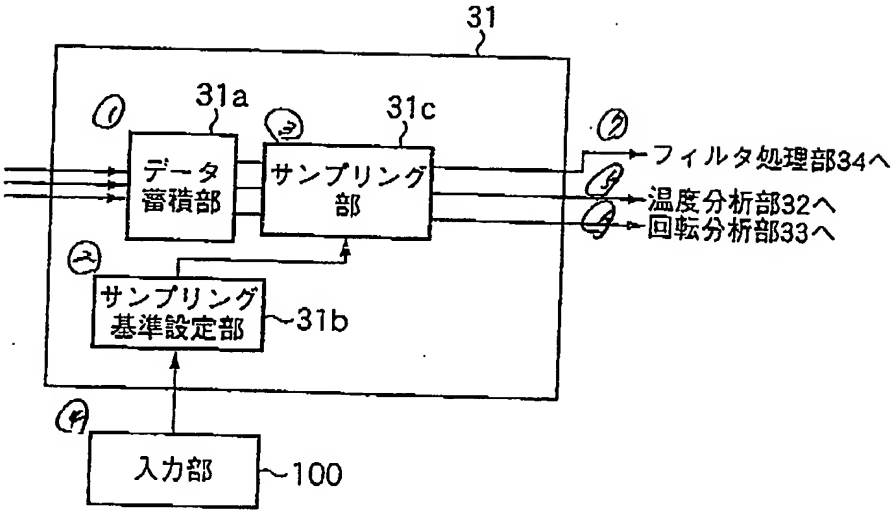

31
31a
31c
データ蓄積部
サンプリング部
フィルタ処理部34へ
温度分析部32へ
回転分析部33へ
サンプリング基準設定部
31b
入力部
100

図4 Fig.4

① 転がり軸受の傷	② エンベロープ処理後の周波数
③ 内輪（Si）	$Zfi=\frac{fr}{2}\left(1+\frac{Da}{dm}\cos\alpha\right)Z$ [Hz]
④ 外輪（So）	$Zfc=\frac{fr}{2}\left(1-\frac{Da}{dm}\cos\alpha\right)Z$ [Hz]
⑤ 転動体（Sb）	$2fb=fr\left(1-\frac{Da^2}{dm^2}\cos^2\alpha\right)$ [Hz]
⑥ 保持器（Sc）	$fc=\frac{fr}{2}\left(1-\frac{Da}{dm}\cos\alpha\right)$ [Hz]

⑦ fr：内輪回転速度［Hz］ ⑪ Z：転動体の数
⑧ fc：保持器回転速度［Hz］ fi：fr－fc
⑨ fb：転動体自転速度［Hz］ ⑫ Da：転動体直径［mm］
⑩ dm：ピッチ円直径［mm］ ⑬ α：接触角［度］

図5 Fig.5

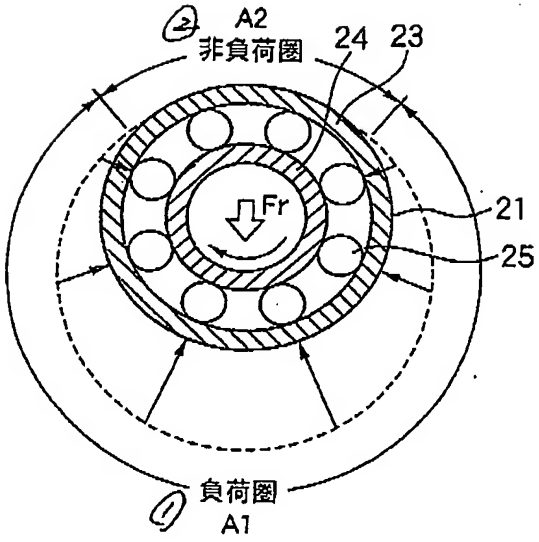


図6 Fig. 6

① 時間波形

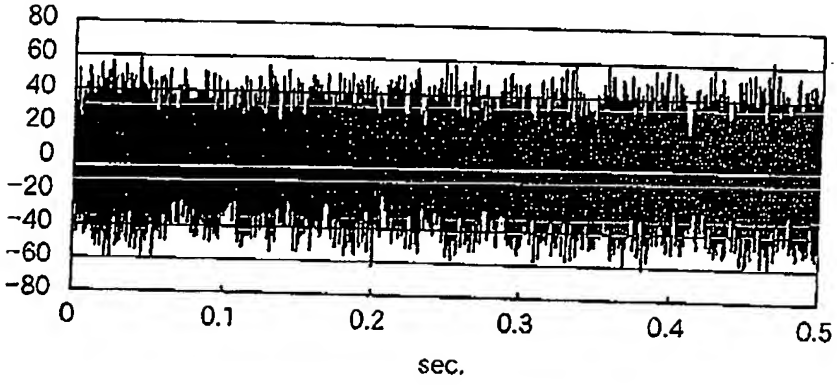


図7 Fig. 7

① FFTスペクトル

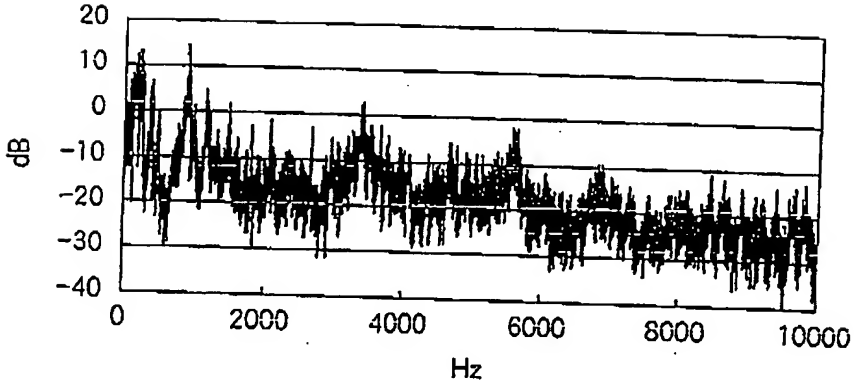


図8 Fig. 8

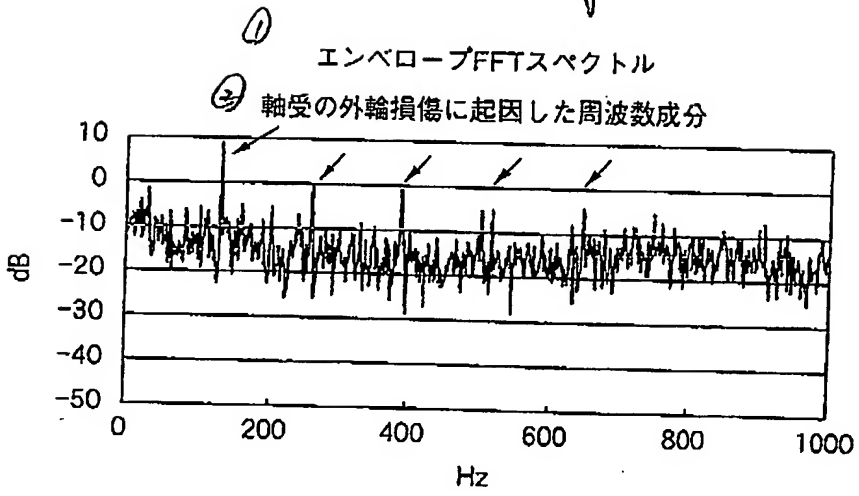

①
エンベロープFFTスペクトル
②
軸受の外輪損傷に起因した周波数成分
10
0
-10
-20
-30
-40
-50
dB
0
200
400
600
800
1000
Hz

図9 Fig.9

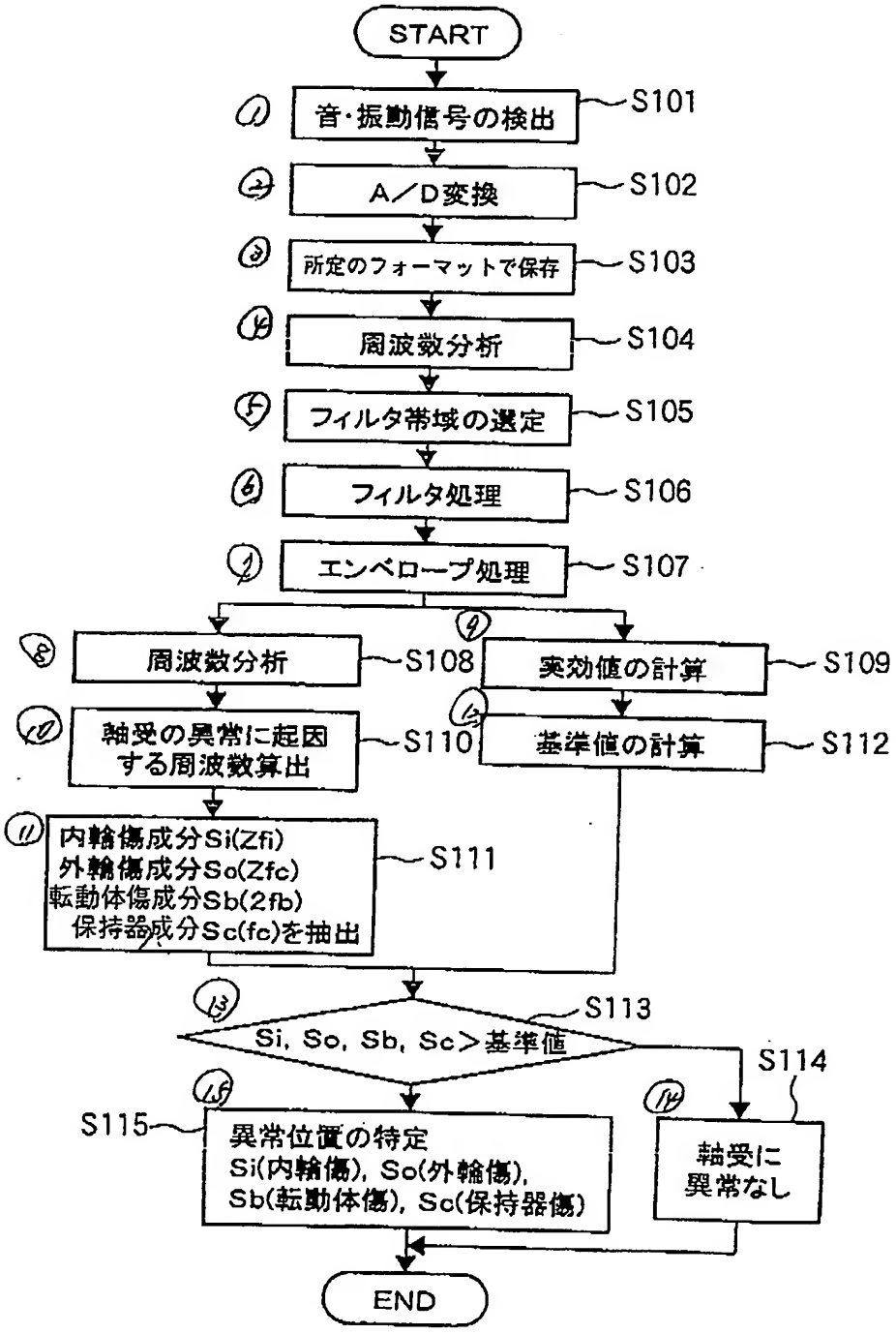

START
① 音・振動信号の検出 S101
② A／D変換 S102
③ 所定のフォーマットで保存 S103
④ 周波数分析 S104
⑤ フィルタ帯域の選定 S105
⑥ フィルタ処理 S106
⑦ エンベロープ処理 S107
⑧ 周波数分析 S108
⑨ 実効値の計算 S109
⑩ 軸受の異常に起因する周波数算出 S110
⑪ 内輪傷成分Si(Zfi)
外輪傷成分So(Zfc)
転動体傷成分Sb(2fb)
保持器成分Sc(fc)を抽出 S111
⑫ 基準値の計算 S112
⑬ Si, So, Sb, Sc＞基準値 S113
S114
⑭ 軸受に異常なし
⑮ 異常位置の特定
Si(内輪傷), So(外輪傷),
Sb(転動体傷), Sc(保持器傷) S115
END

図10 Fig. 10

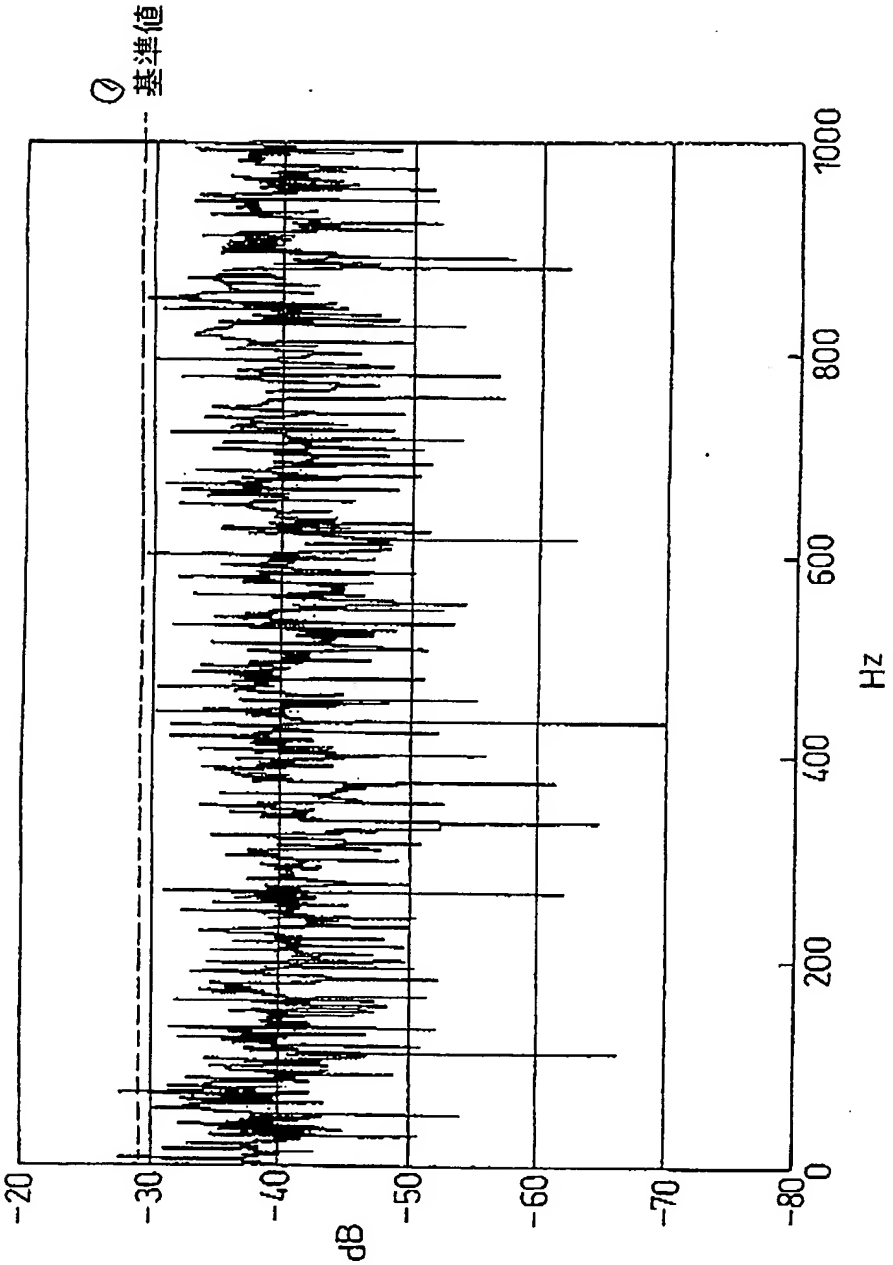


図11 Fig.11

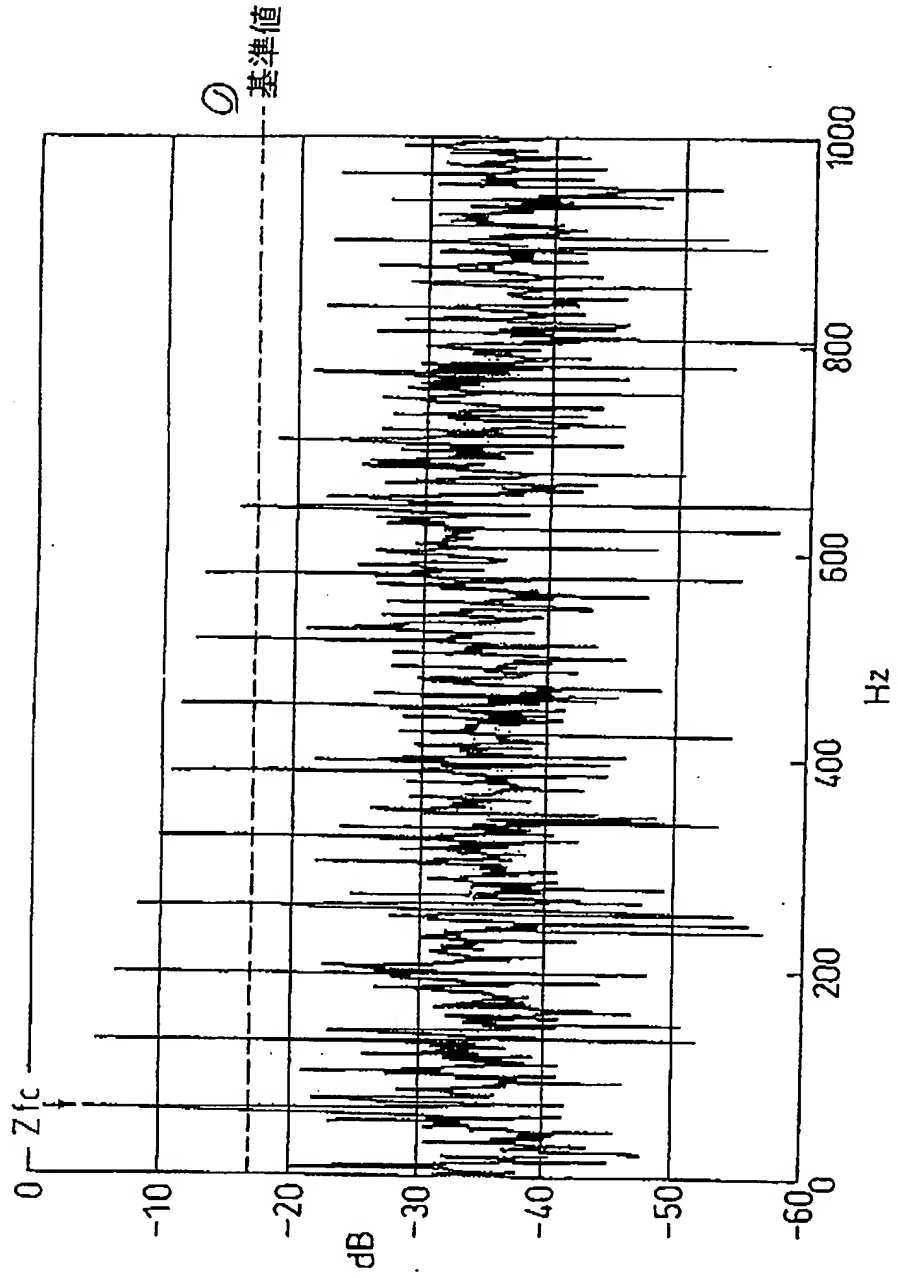


図12 Fig.12

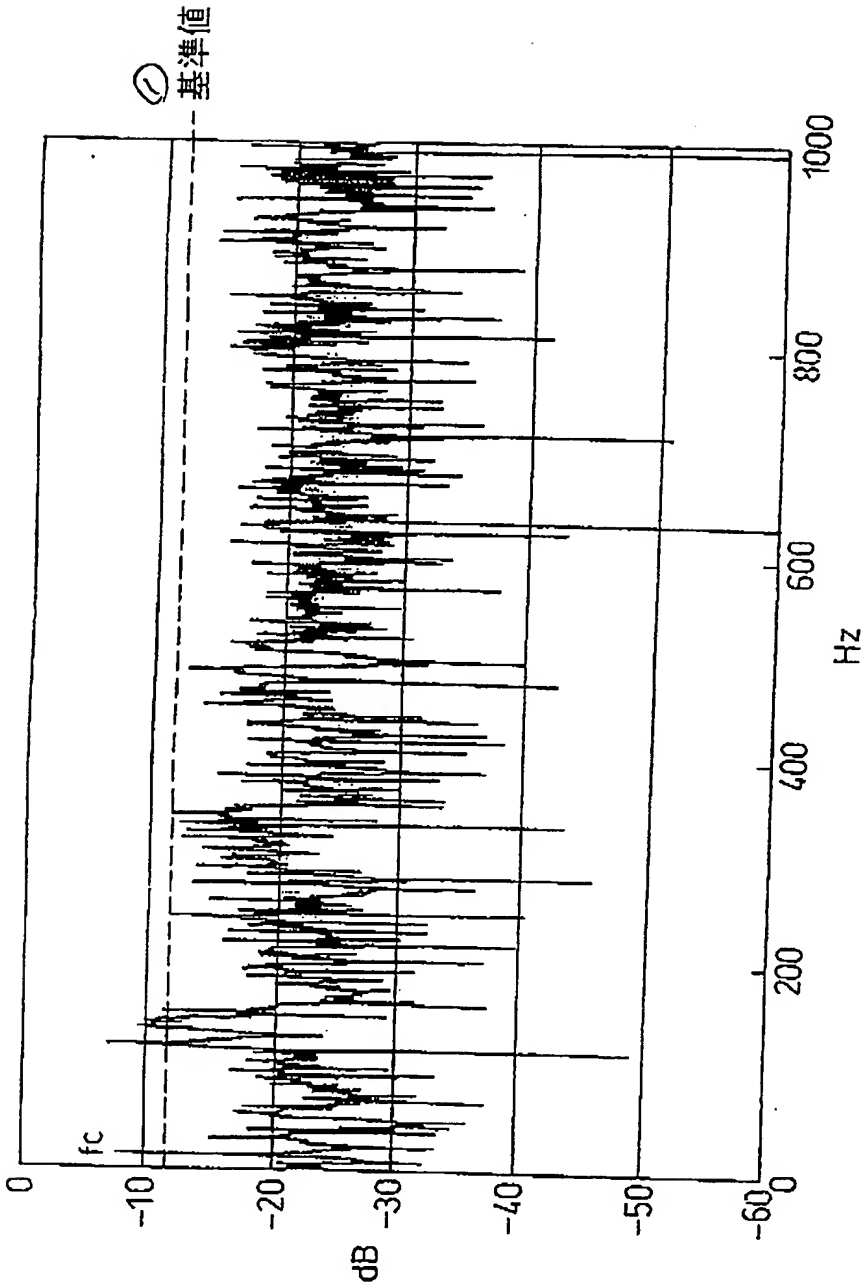


図13 Fig. 13

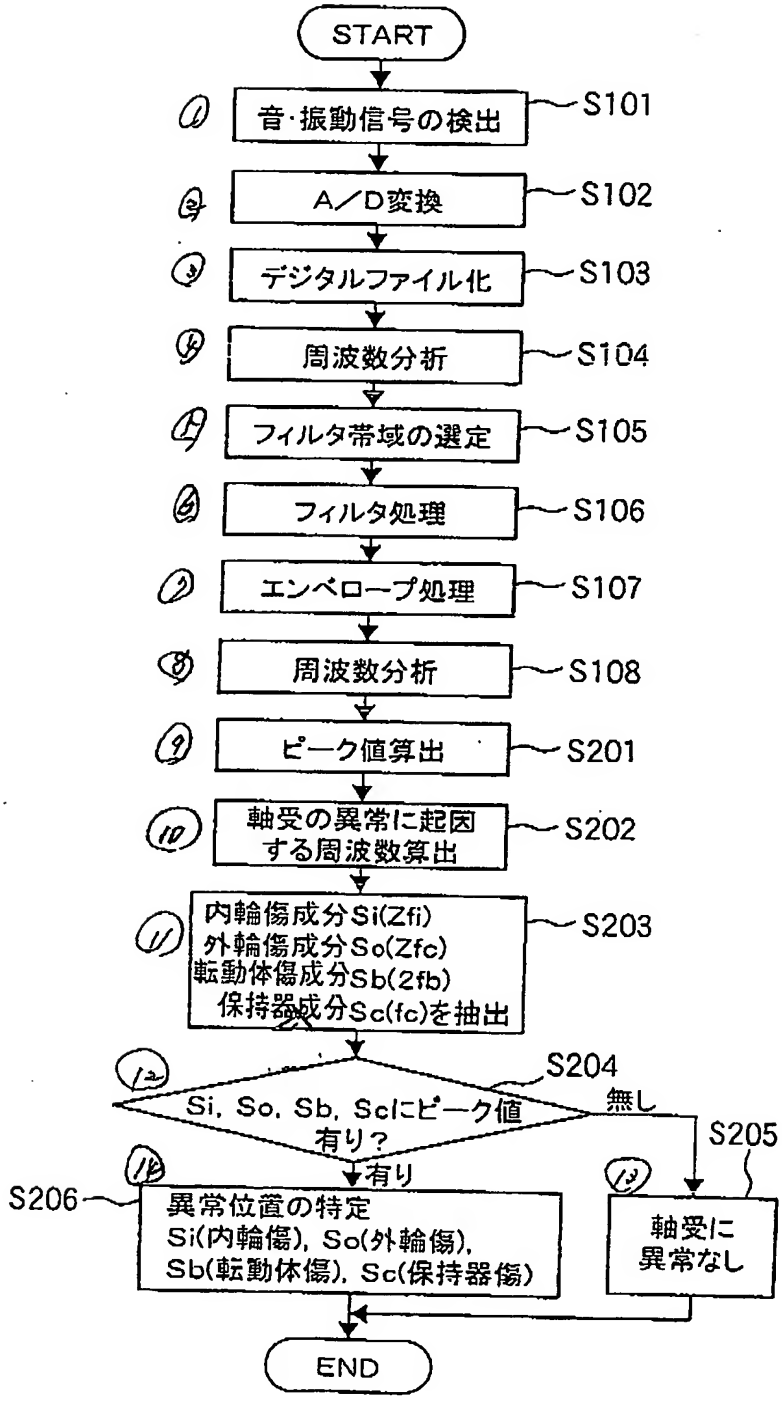
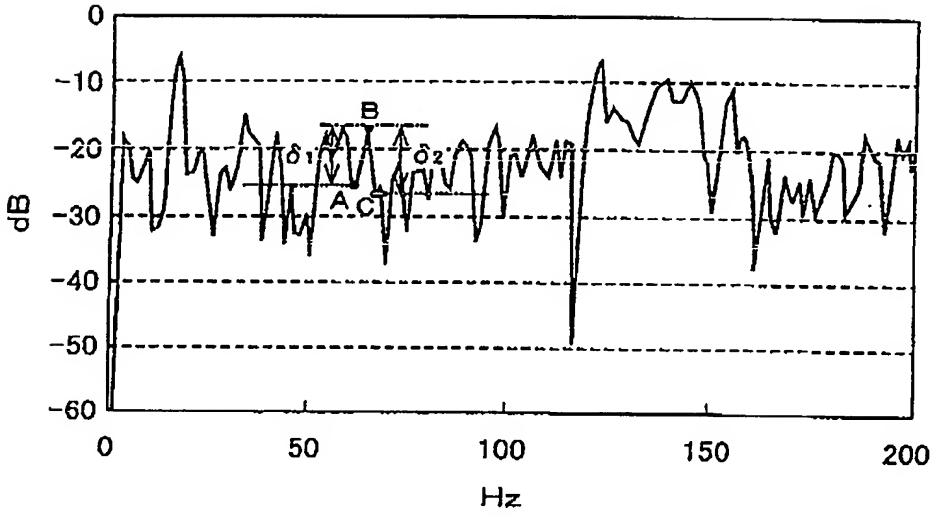

START
①
音·振動信号の検出
S101
②
A／D変換
S102
③
デジタルファイル化
S103
④
周波数分析
S104
⑤
フィルタ帯域の選定
S105
⑥
フィルタ処理
S106
⑦
エンベロープ処理
S107
⑧
周波数分析
S108
⑨
ピーク値算出
S201
⑩
軸受の異常に起因する周波数算出
S202
⑪
内輪傷成分Si(Zfi)
外輪傷成分So(Zfc)
転動体傷成分Sb(2fb)
保持器成分Sc(fc)を抽出
S203
⑫
S204
Si, So, Sb, Scにピーク値有り？
無し
S205
有り
⑬
軸受に異常なし
⑭
S206
異常位置の特定
Si(内輪傷), So(外輪傷),
Sb(転動体傷), Sc(保持器傷)
END

図14 Fig. 14



①

A(X_0, Y_0), B(X_1, Y_1), C(X_2, Y_2)とすると

$\delta_1(=Y_1-Y_0) > 0$, −①

$\delta_2(=Y_2-Y_1) < 0$, −②

①, ②を満たし,

$dy/dx=(Y_1-Y_0)/(X_1-X_0) > 1$

または,

$dy/dx=(Y_2-Y_1)/(X_2-X_1) < -1$

を満たすとき, Y_1をピークとする.

図15 Fig. 15

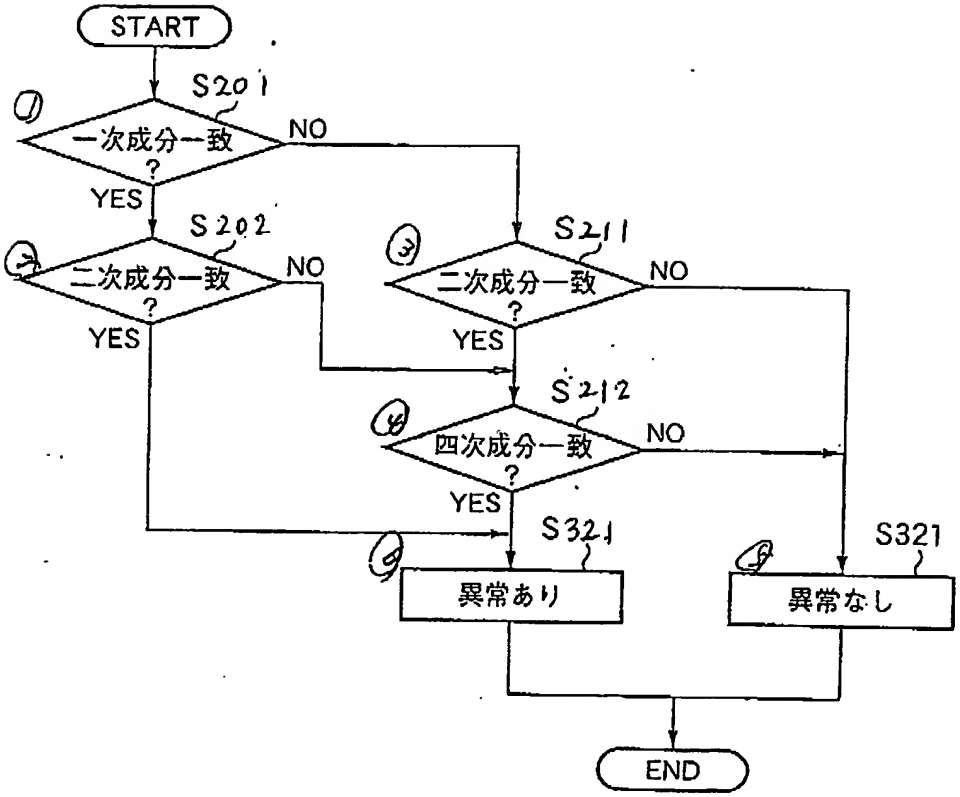
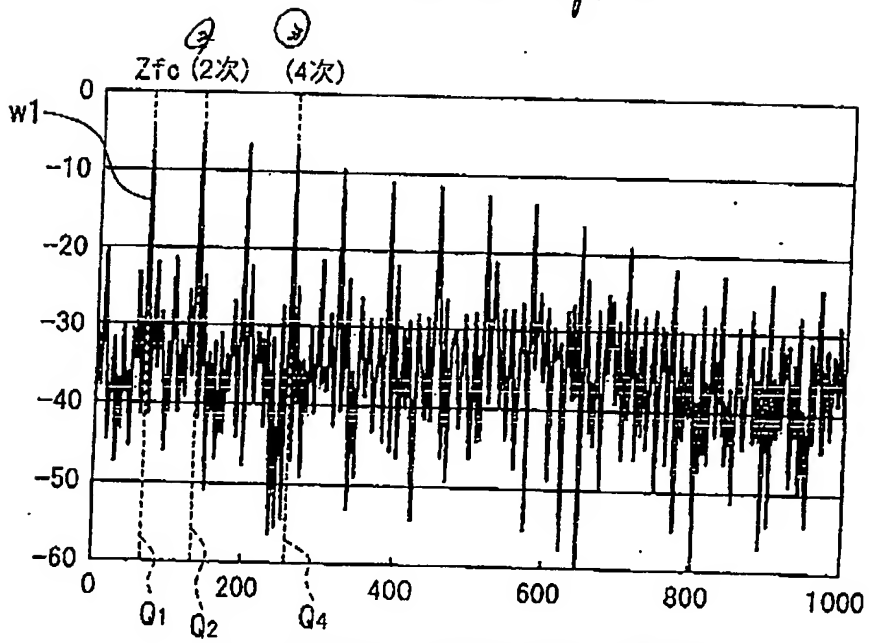

START
S201
一次成分一致
?
NO
YES
S202
二次成分一致
?
NO
YES
S211
二次成分一致
?
NO
YES
S212
四次成分一致
?
NO
YES
S321
異常あり
S321
異常なし
END

図16 Fig. 16



① 1, 2, 4次のみの成分を照合(外輪きず)

図17 Fig.17

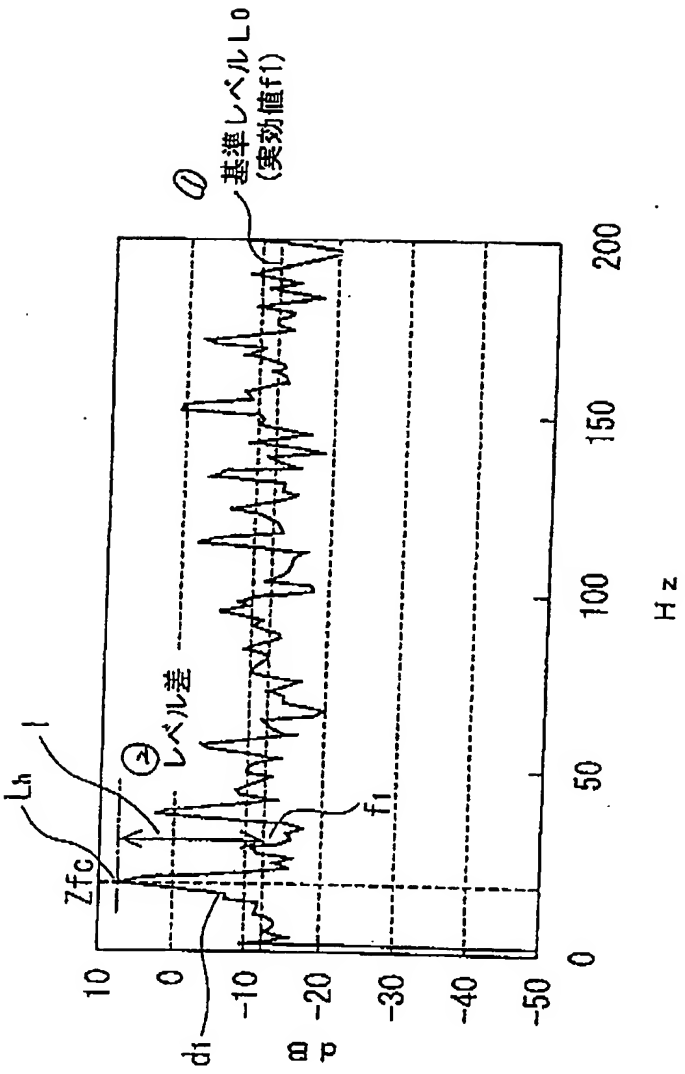
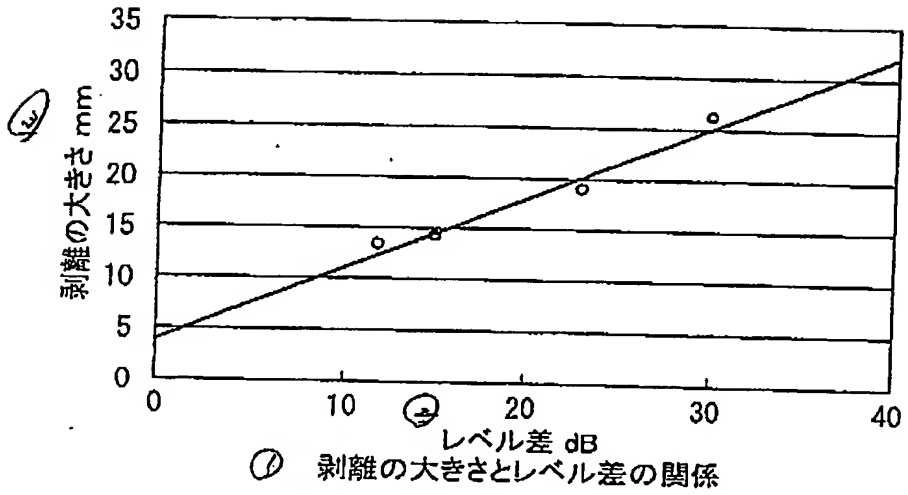
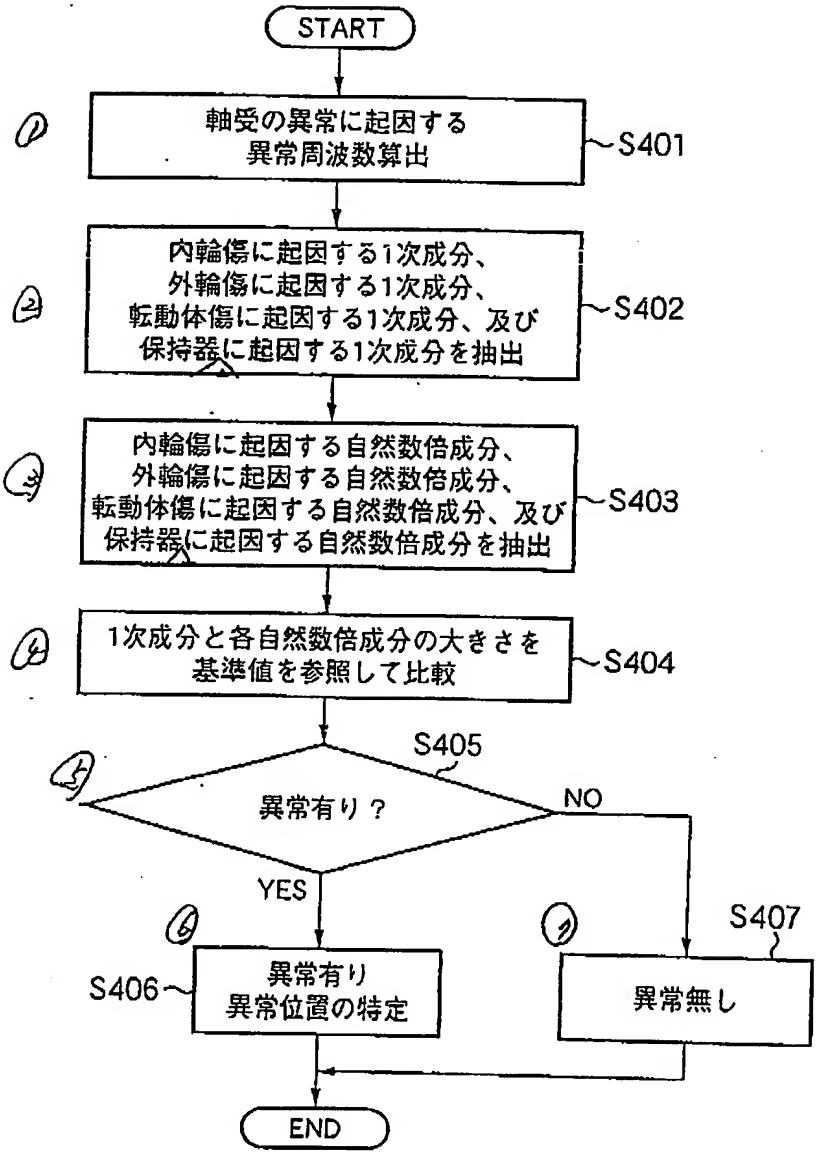

基準レベルLo
(実効値f1)
レベル差
Lh
Zfc
f1
d1
10
0
-10
-20
-30
-40
-50
dB
0
50
100
150
200
Hz

図18 Fig. 18



① 剥離の大きさとレベル差の関係

図19 Fig. 19


START
①
軸受の異常に起因する
異常周波数算出
S401
②
内輪傷に起因する1次成分、
外輪傷に起因する1次成分、
転動体傷に起因する1次成分、及び
保持器に起因する1次成分を抽出
S402
③
内輪傷に起因する自然数倍成分、
外輪傷に起因する自然数倍成分、
転動体傷に起因する自然数倍成分、及び
保持器に起因する自然数倍成分を抽出
S403
④
1次成分と各自然数倍成分の大きさを
基準値を参照して比較
S404
⑤
S405
異常有り？
NO
YES
⑥
S406
異常有り
異常位置の特定
⑦
S407
異常無し
END

図~~20~~ Fig. 20

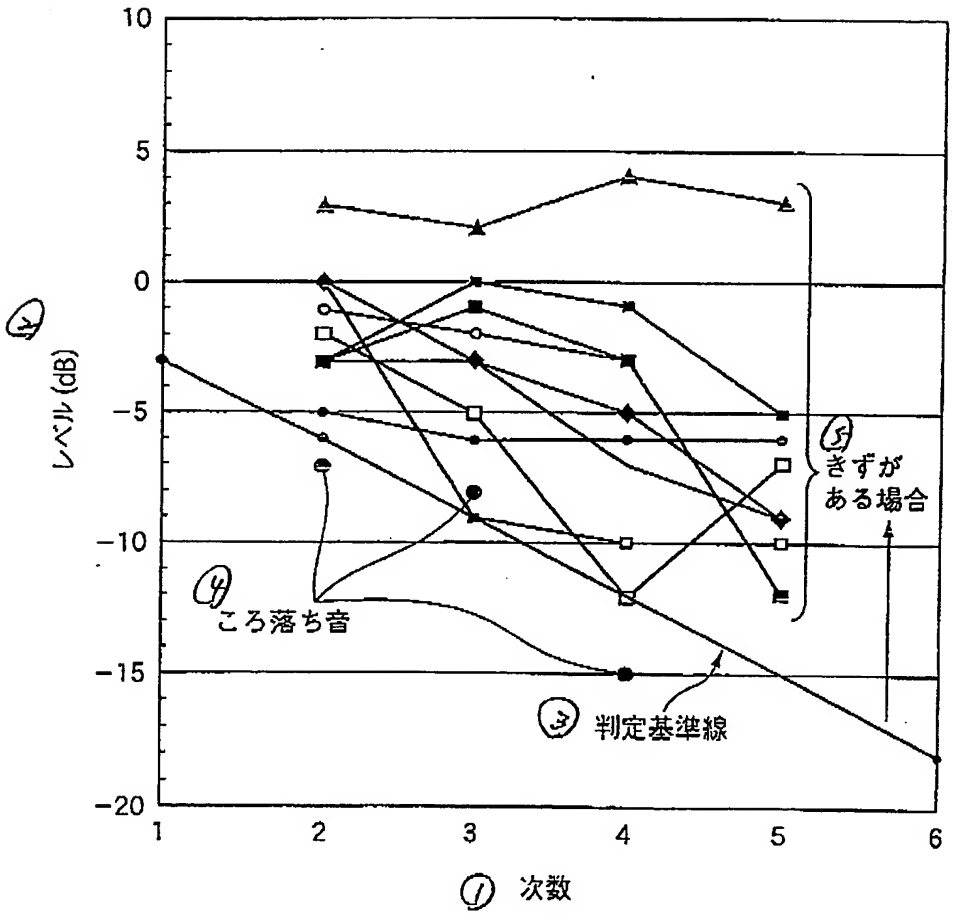


図21 Fig.21

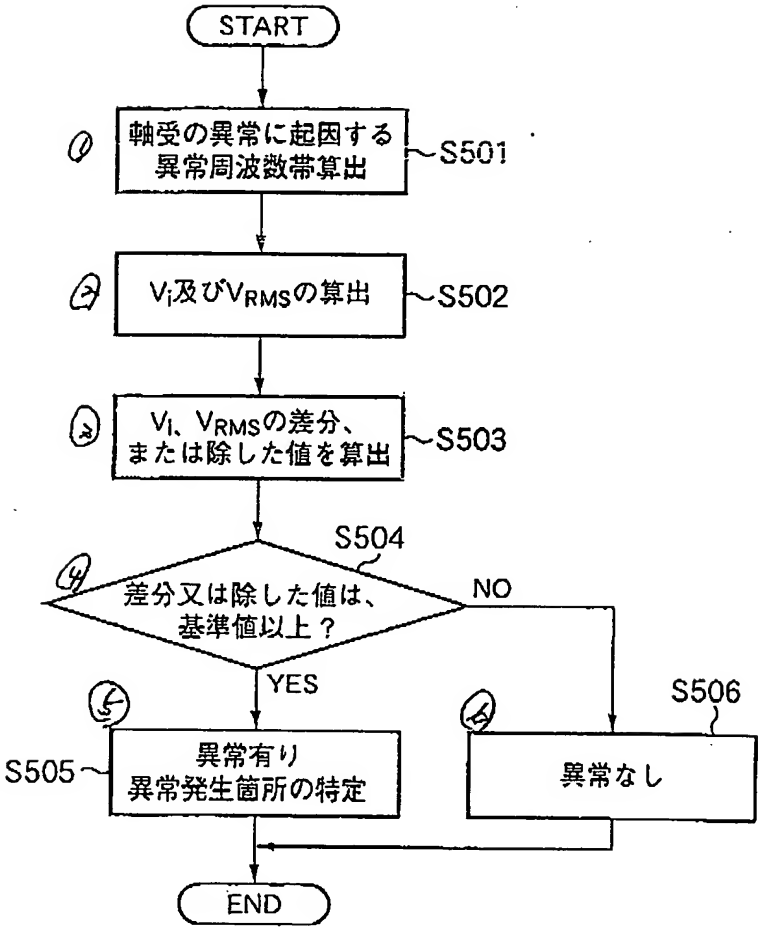

START
①
軸受の異常に起因する
異常周波数帯算出
S501
②
Vi及びVRMSの算出
S502
③
VI、VRMSの差分、
または除した値を算出
S503
S504
④
差分又は除した値は、
基準値以上？
NO
YES
⑤
異常有り
異常発生箇所の特定
S505
⑥
異常なし
S506
END

図22 Fig. 22

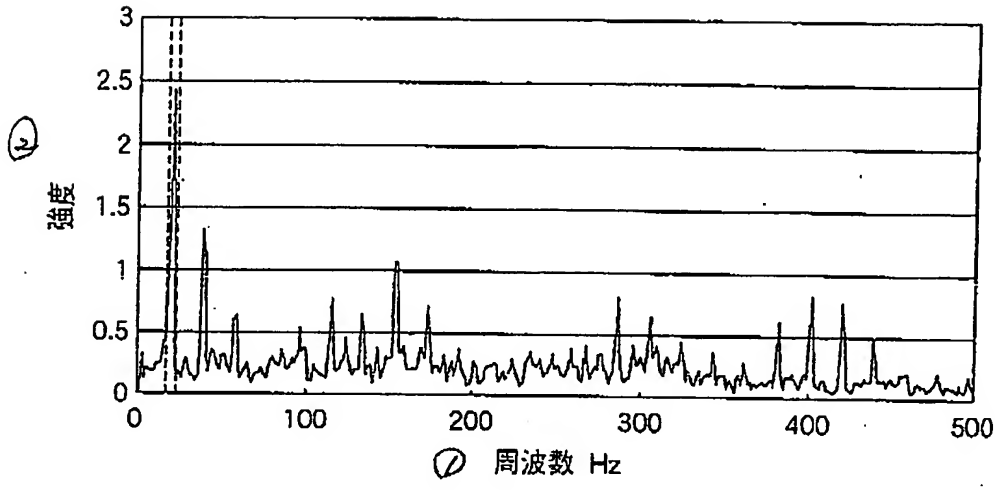
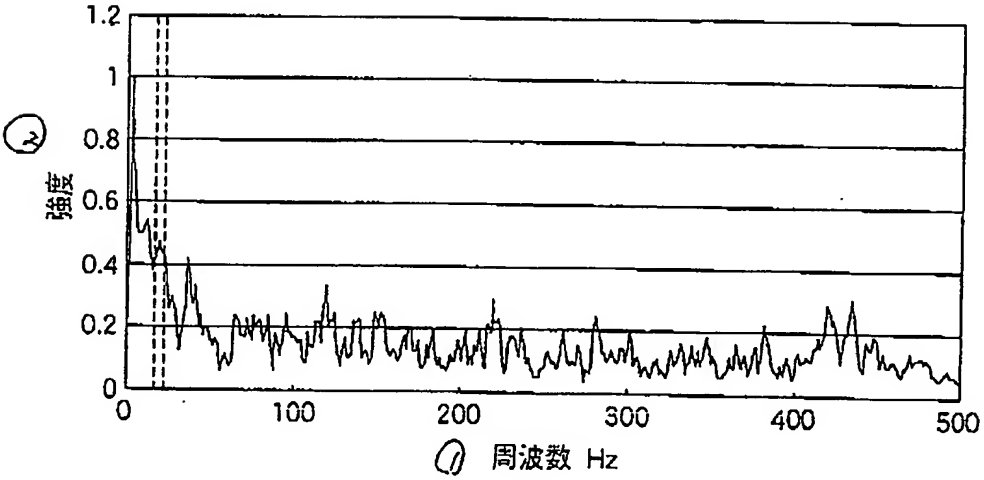
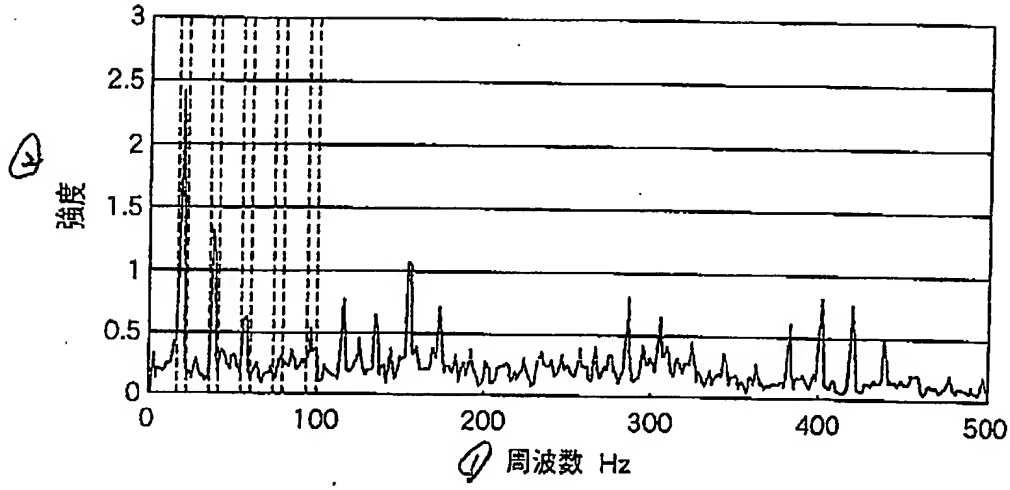


図23 Fig. 23



図~~24~~ Fig. 24



図~~25~~ Fig. 25

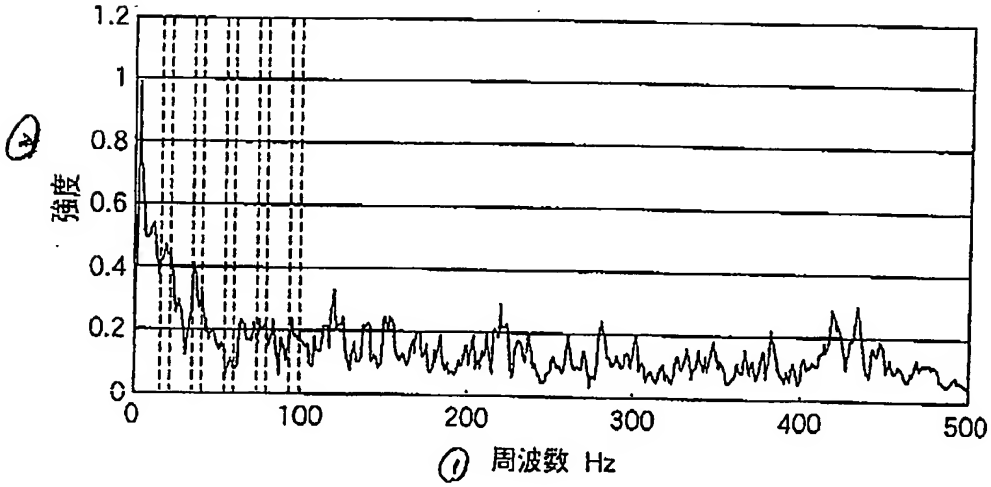


図26 Fig. 26

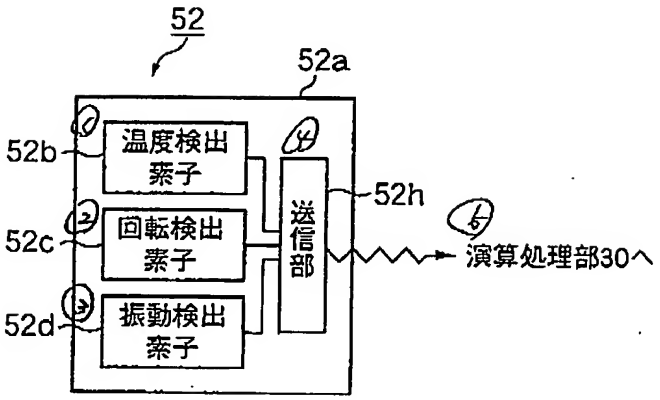


図27 Fig. 27

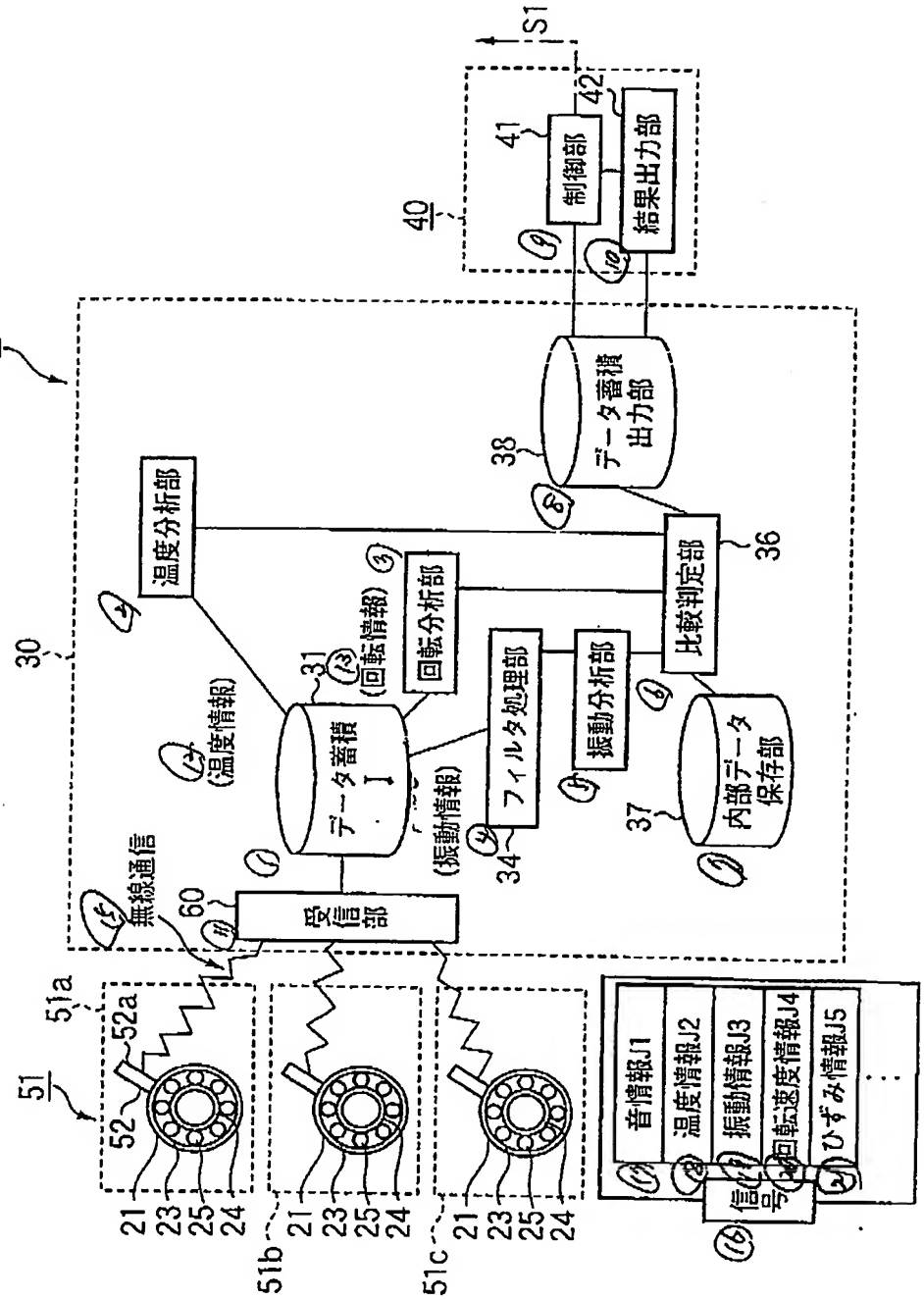

1
30
40
S1
41
制御部
42
結果出力部
38
データ蓄積出力部
温度分析部
回転分析部
比較判定部
36
31
データ蓄積部
フィルタ処理部
振動分析部
37
内部データ保存部
34
(温度情報)
(回転情報)
(振動情報)
無線通信
60
受信部
51
51a
52
52a
21
23
25
24
51b
51c
音情報J1
温度情報J2
振動情報J3
回転速度情報J4
ひずみ情報J5
信号

図28 Fig. 28

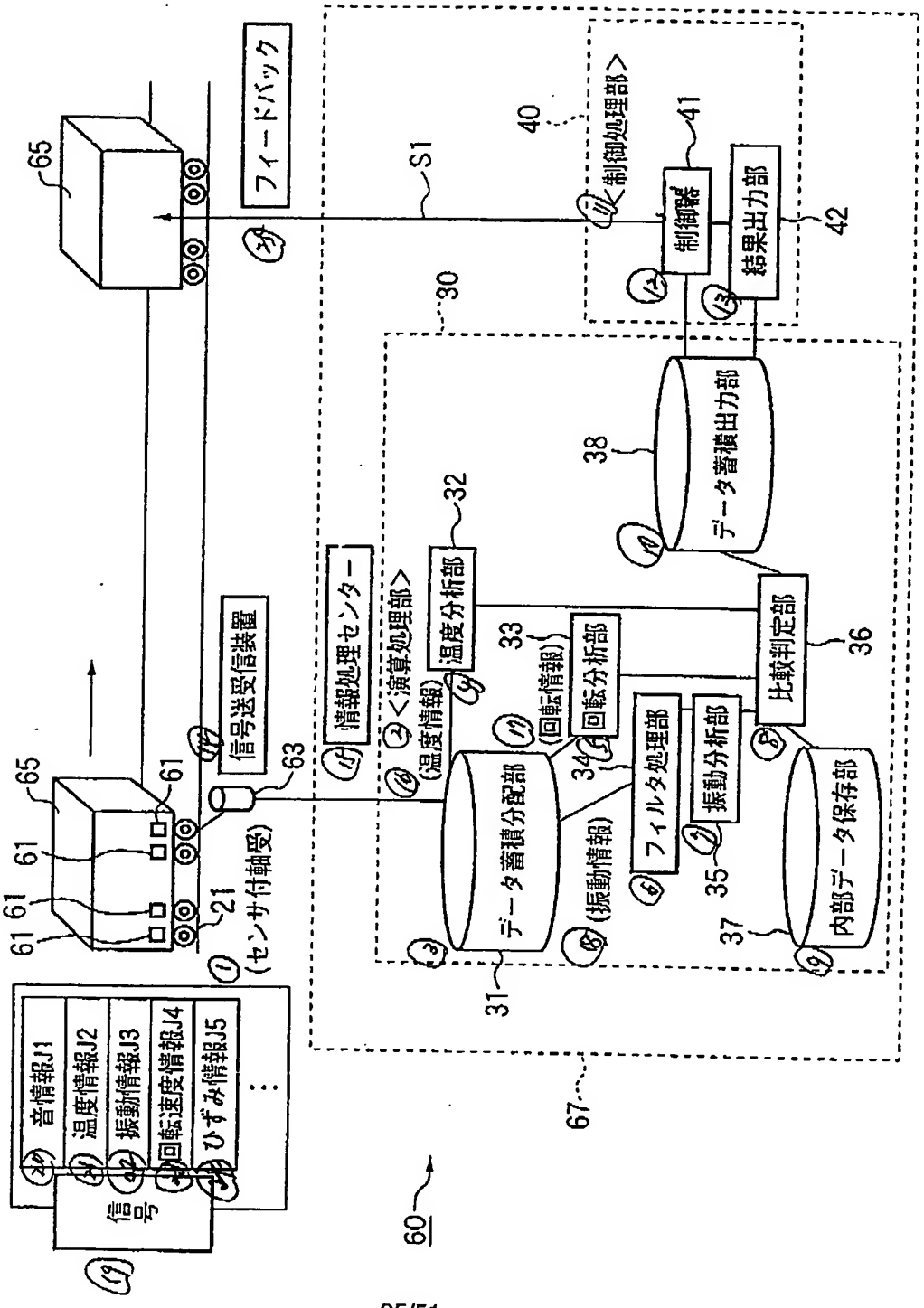
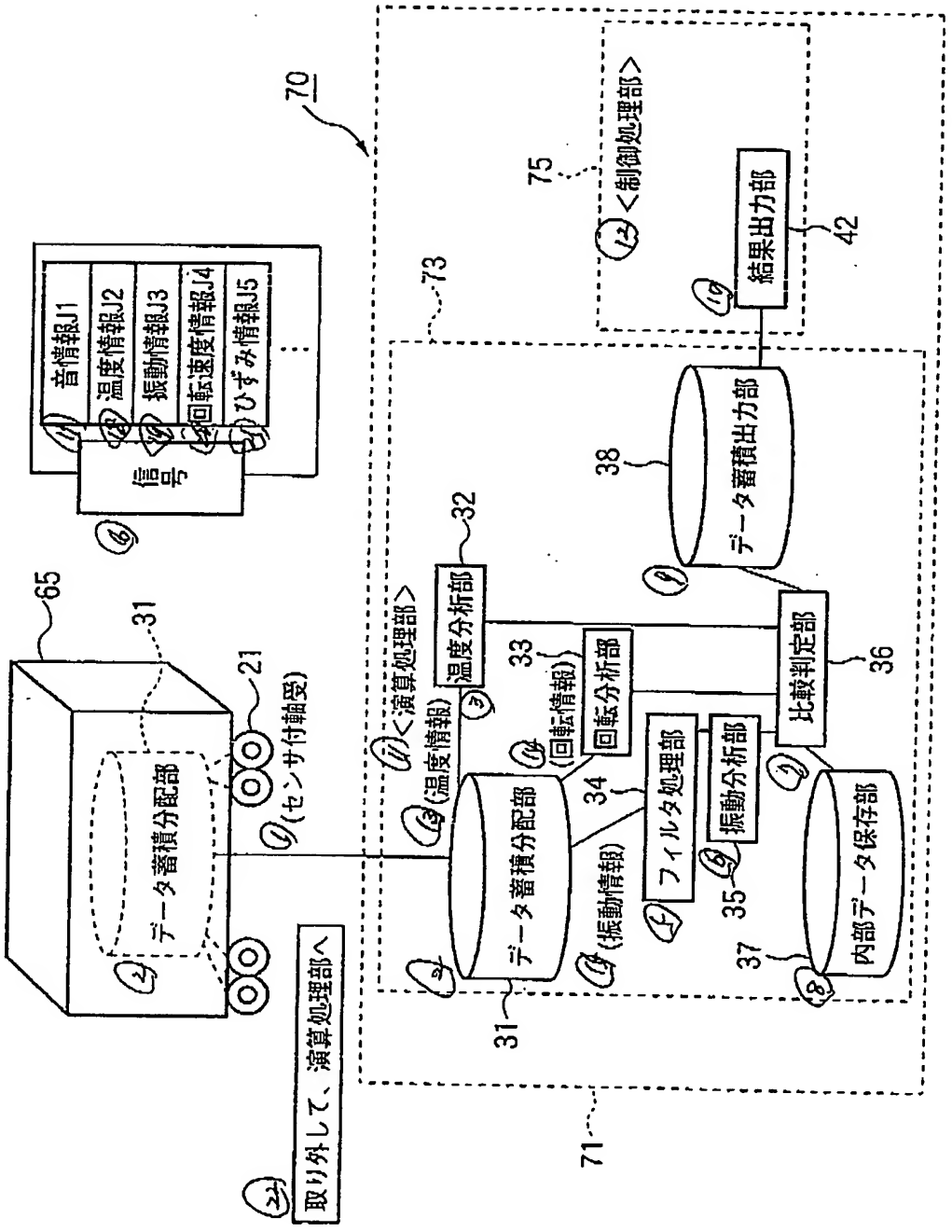
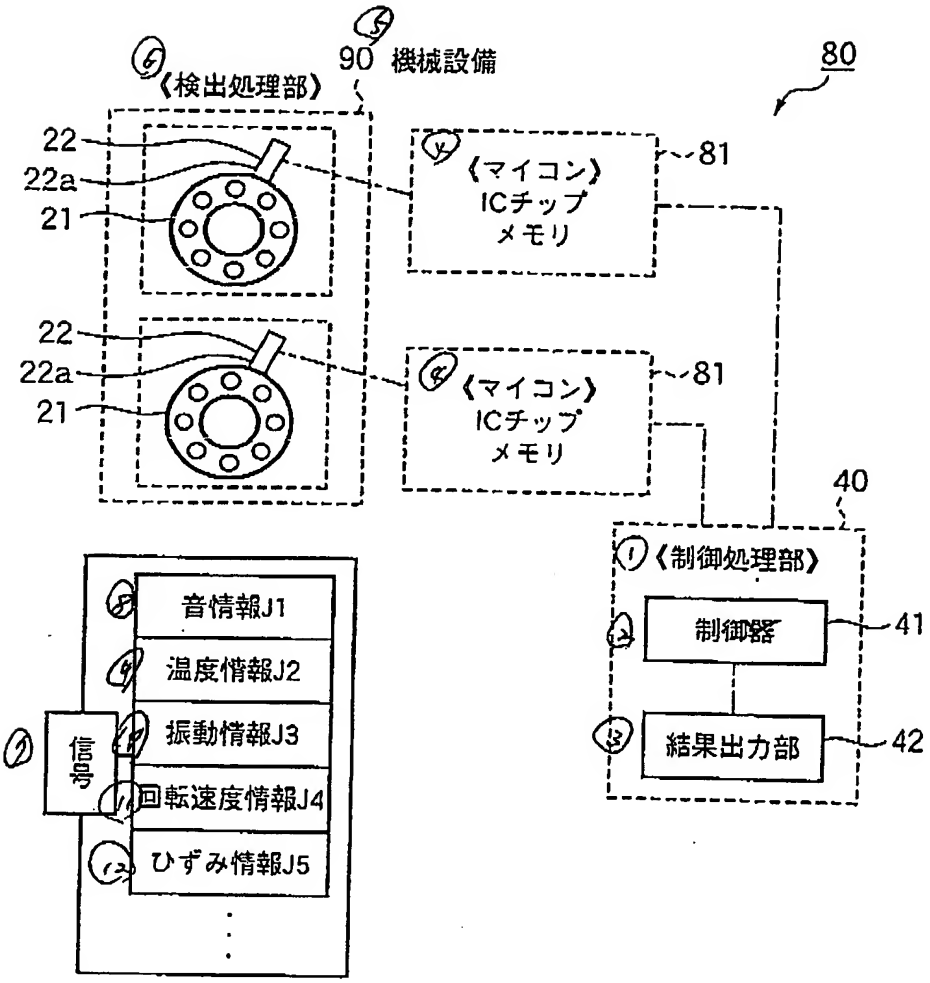

音情報J1
温度情報J2
振動情報J3
回転速度情報J4
ひずみ情報J5
信号
(センサ付軸受)
信号送受信装置
情報処理センター
<演算処理部>
(温度情報)
(振動情報)
(回転情報)
温度分析部
回転分析部
フィルタ処理部
振動分析部
比較判定部
データ蓄積分配部
データ蓄積出力部
内部データ保存部
制御処理部
制御器
結果出力部
フィードバック
S1
30
31
32
33
34
35
36
37
38
40
41
42
60
61
63
65
67

図29 Fig. 29


70
音情報J1
温度情報J2
振動情報J3
回転速度情報J4
ひずみ情報J5
信号
65
31
21
データ蓄積分配部
(センサ付軸受)
取り外して、演算処理部へ
<演算処理部>
(温度情報)
(振動情報)
(回転情報)
温度分析部
回転分析部
振動分析部
フィルタ処理部
データ蓄積分配部
比較判定部
内部データ保存部
データ蓄積出力部
<制御処理部>
結果出力部
73
75
71
32
33
34
35
36
37
38
42

図~~30~~ Fig. 30


⑥《検出処理部》
⑤90 機械設備
80
22
22a
21
⑤《マイコン》
ICチップ
メモリ
81
22
22a
21
⑥《マイコン》
ICチップ
メモリ
81
40
⑦《制御処理部》
⑫制御器
41
⑬結果出力部
42
⑧音情報J1
⑨温度情報J2
⑩振動情報J3
⑪回転速度情報J4
⑫ひずみ情報J5
⑦信号

図~~31~~ Fig. 31

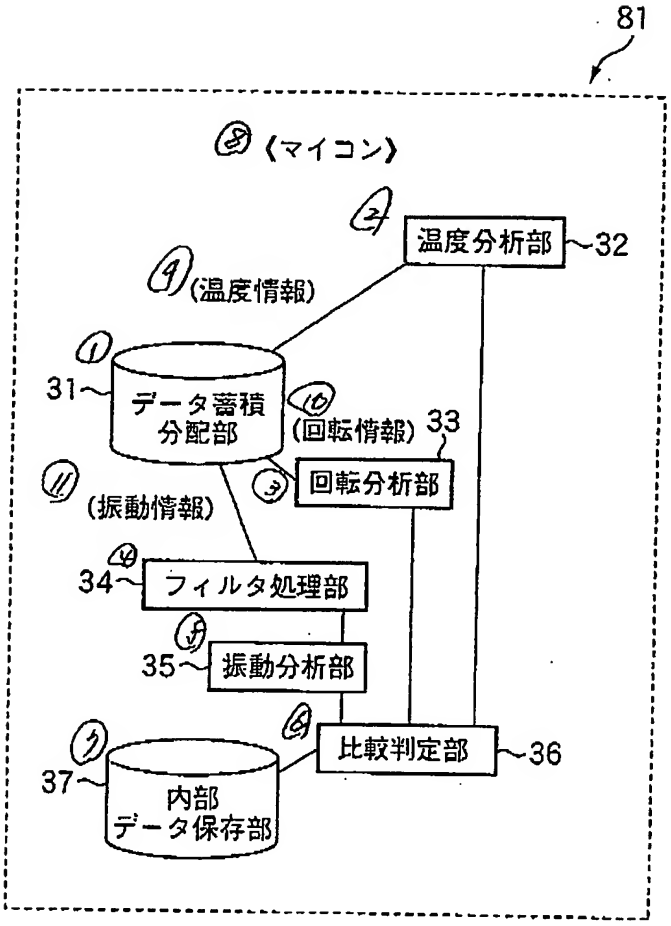

81
⑧ (マイコン)
② 温度分析部 32
⑨ (温度情報)
① 31 データ蓄積分配部
⑩ (回転情報) 33
③ 回転分析部
⑪ (振動情報)
④ 34 フィルタ処理部
⑤ 35 振動分析部
⑥ 比較判定部 36
⑦ 37 内部データ保存部

図32 Fig.32

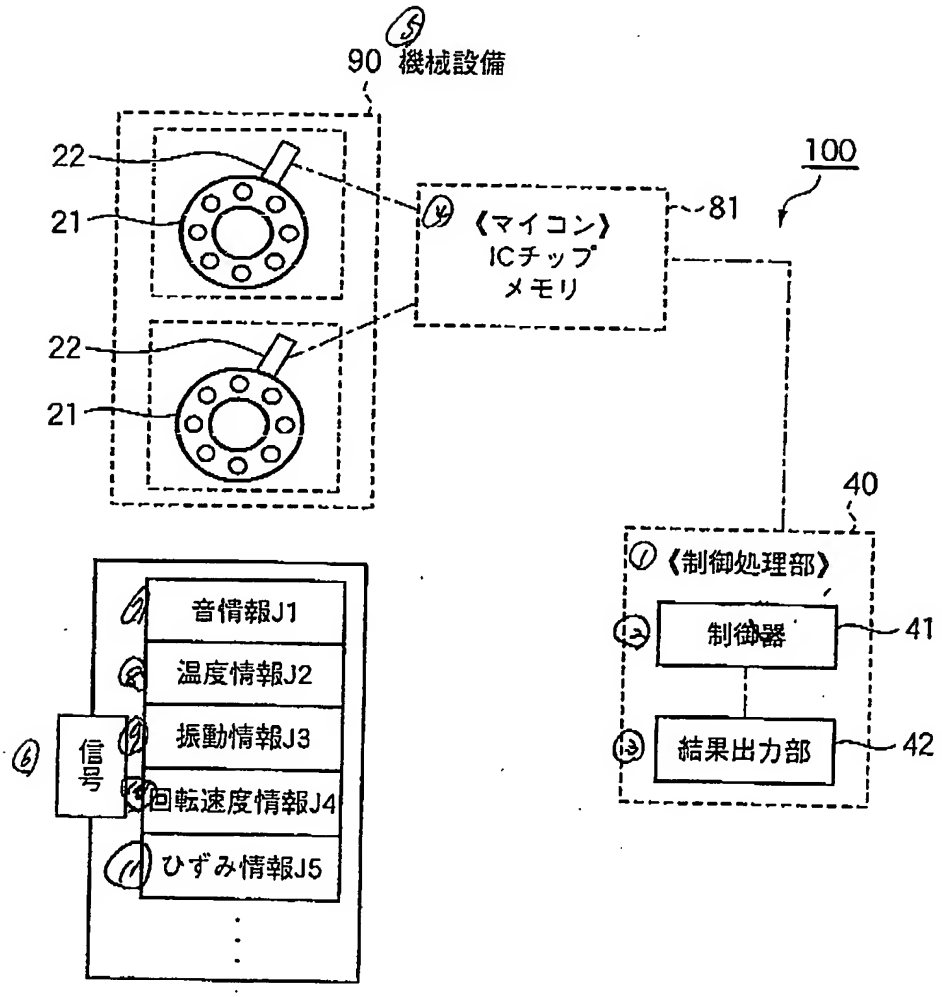

⑤
90 機械設備
22
21
22
21
100
81
④《マイコン》
ICチップ
メモリ
40
①《制御処理部》
⑫ 制御器
41
⑬ 結果出力部
42
⑥ 信号
⑦ 音情報J1
⑧ 温度情報J2
⑨ 振動情報J3
⑩ 回転速度情報J4
⑪ ひずみ情報J5

図33 Fig.33

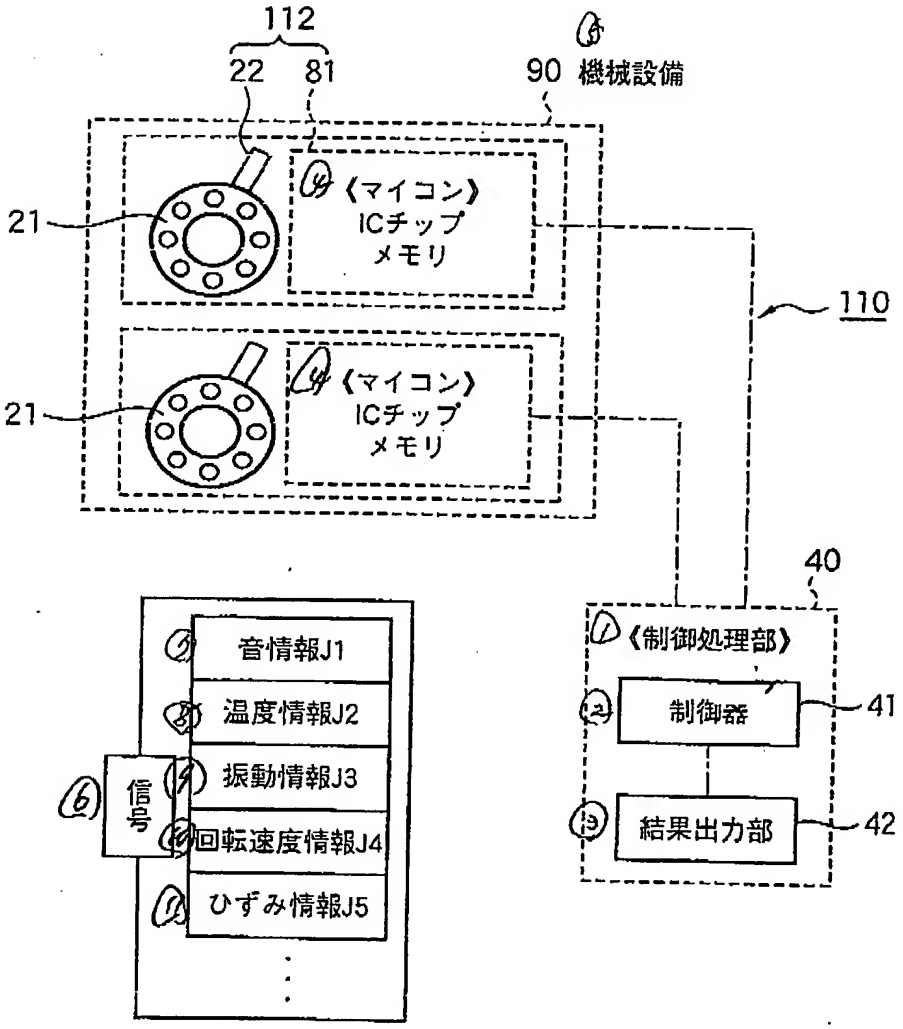

112
22
81
90
機械設備
21
《マイコン》
ICチップ
メモリ
110
21
《マイコン》
ICチップ
メモリ
40
《制御処理部》
制御器
41
結果出力部
42
信号
音情報J1
温度情報J2
振動情報J3
回転速度情報J4
ひずみ情報J5

Fig.34
図34(a)

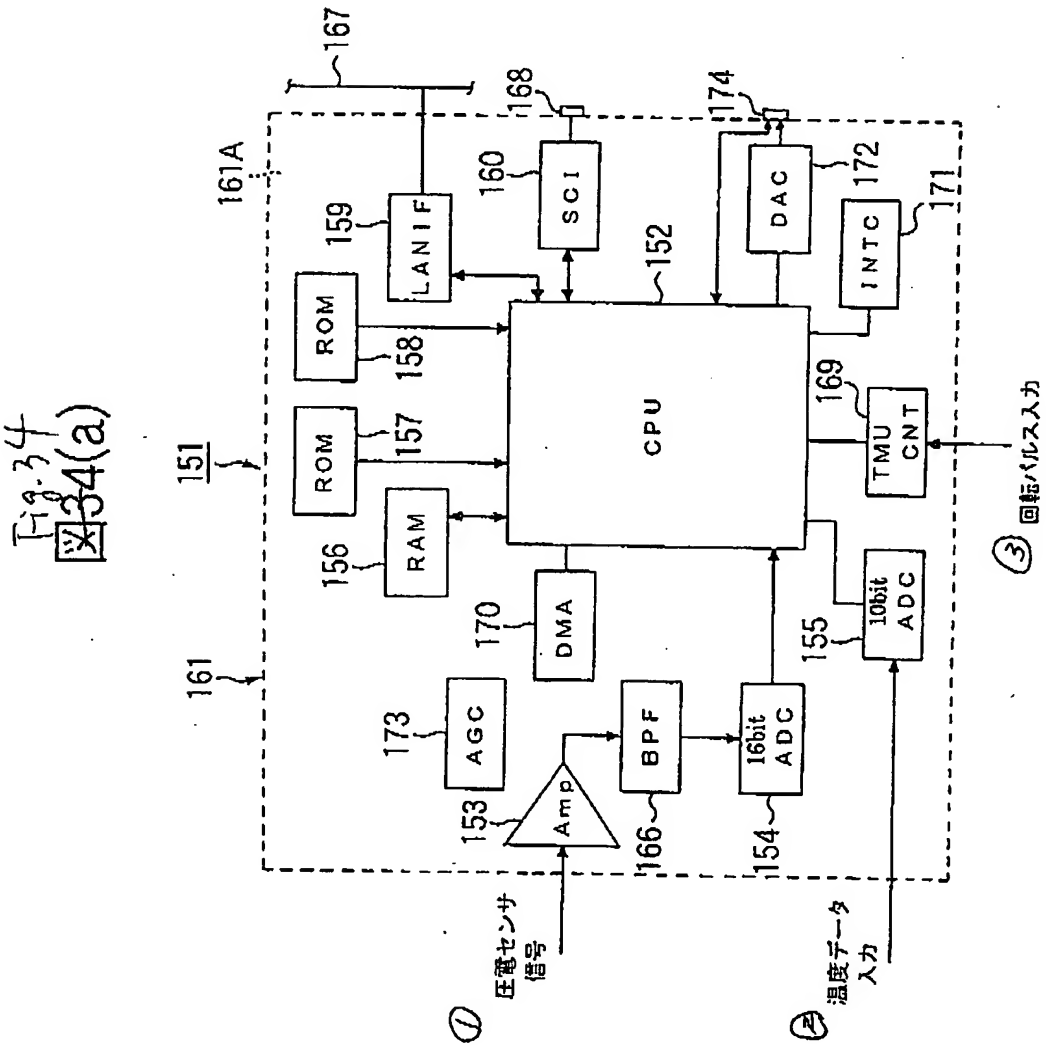


Fig.34
図34(b)

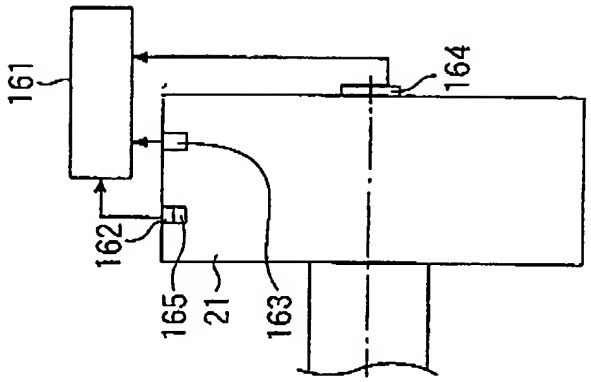


Fig. 35
図35(a)

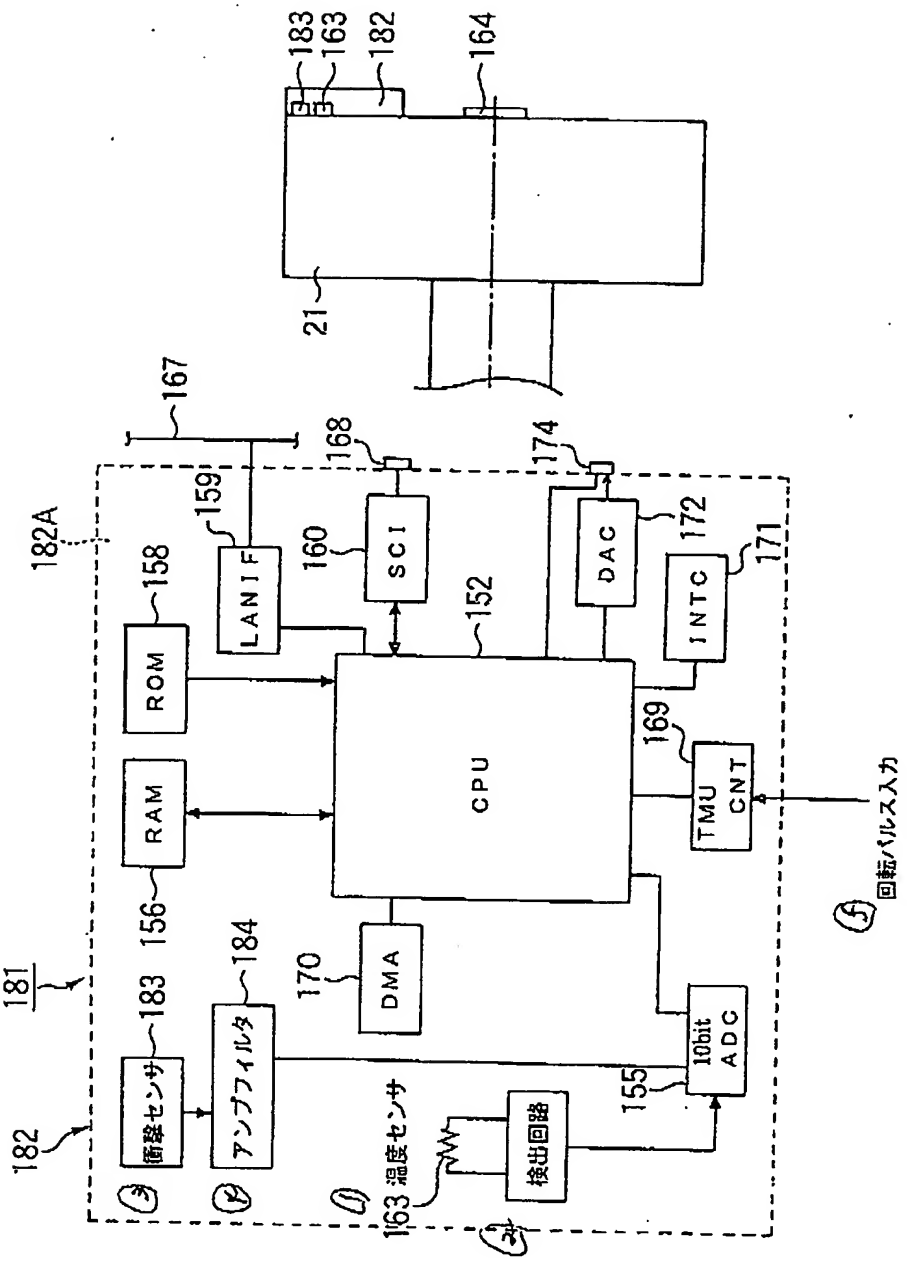


Fig. 35
図35(b)

Fig. 36

図36

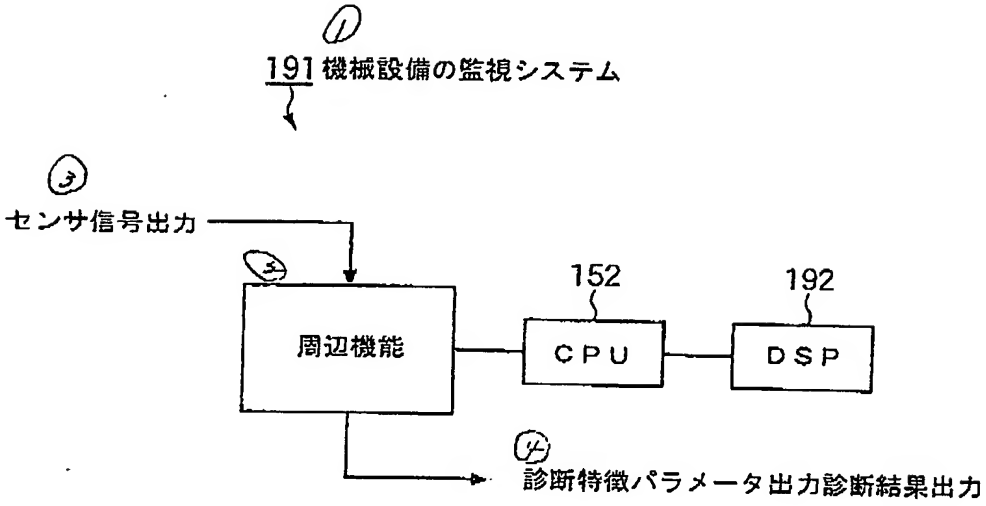

①
191 機械設備の監視システム
③
センサ信号出力
②
152
192
周辺機能
CPU
DSP
④
診断特徴パラメータ出力診断結果出力

図37 Fig. 37

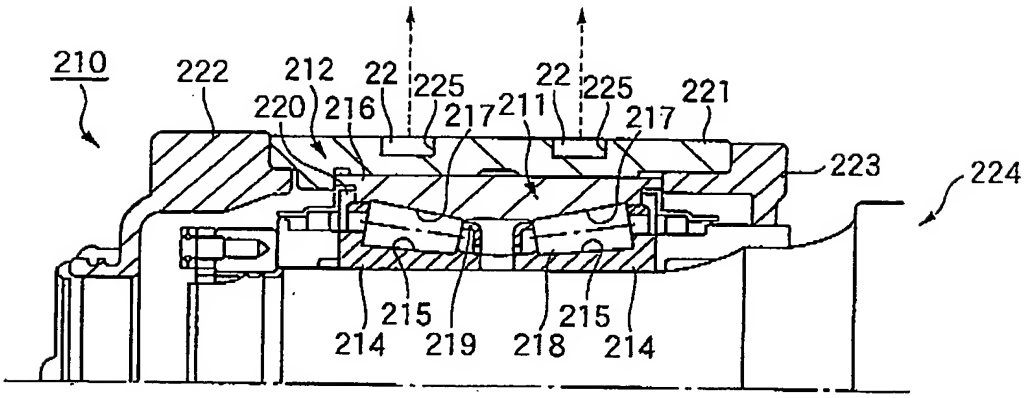

210
222
212
22
225
22
225
221
220
216
217
211
217
223
224
215
214
219
218
215
214

図38 Fig. 38

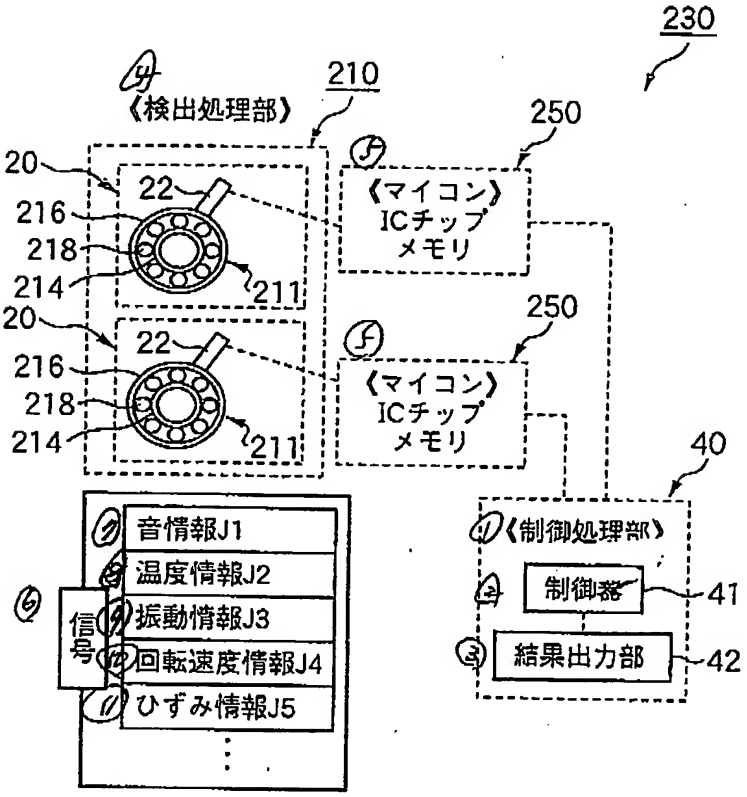

230
④
《検出処理部》
210
250
⑦
《マイコン》
ICチップ
メモリ
20
22
216
218
214
211
20
22
216
218
214
211
250
⑦
《マイコン》
ICチップ
メモリ
40
⑤
音情報J1
温度情報J2
⑥
信号
振動情報J3
回転速度情報J4
ひずみ情報J5
⑩
《制御処理部》
⑫
制御器
41
⑬
結果出力部
42

図39 Fig. 39

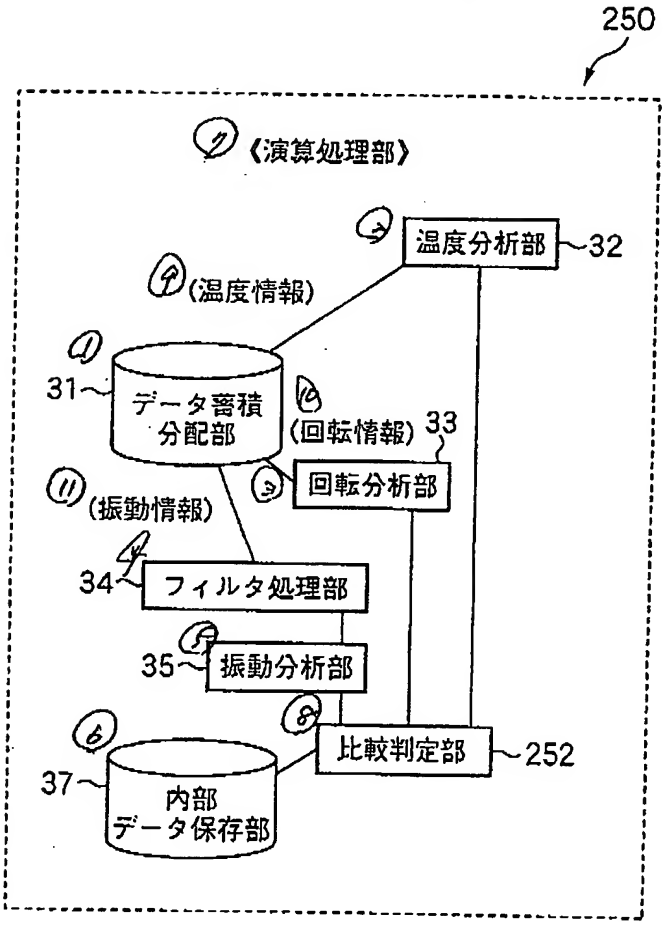

250
⑦《演算処理部》
②
温度分析部
32
④(温度情報)
①
31
データ蓄積
分配部
⑩(回転情報)
33
③
回転分析部
⑪(振動情報)
⑨
34
フィルタ処理部
⑤
35
振動分析部
⑧
⑥
比較判定部
252
37
内部
データ保存部

図40 Fig. 40

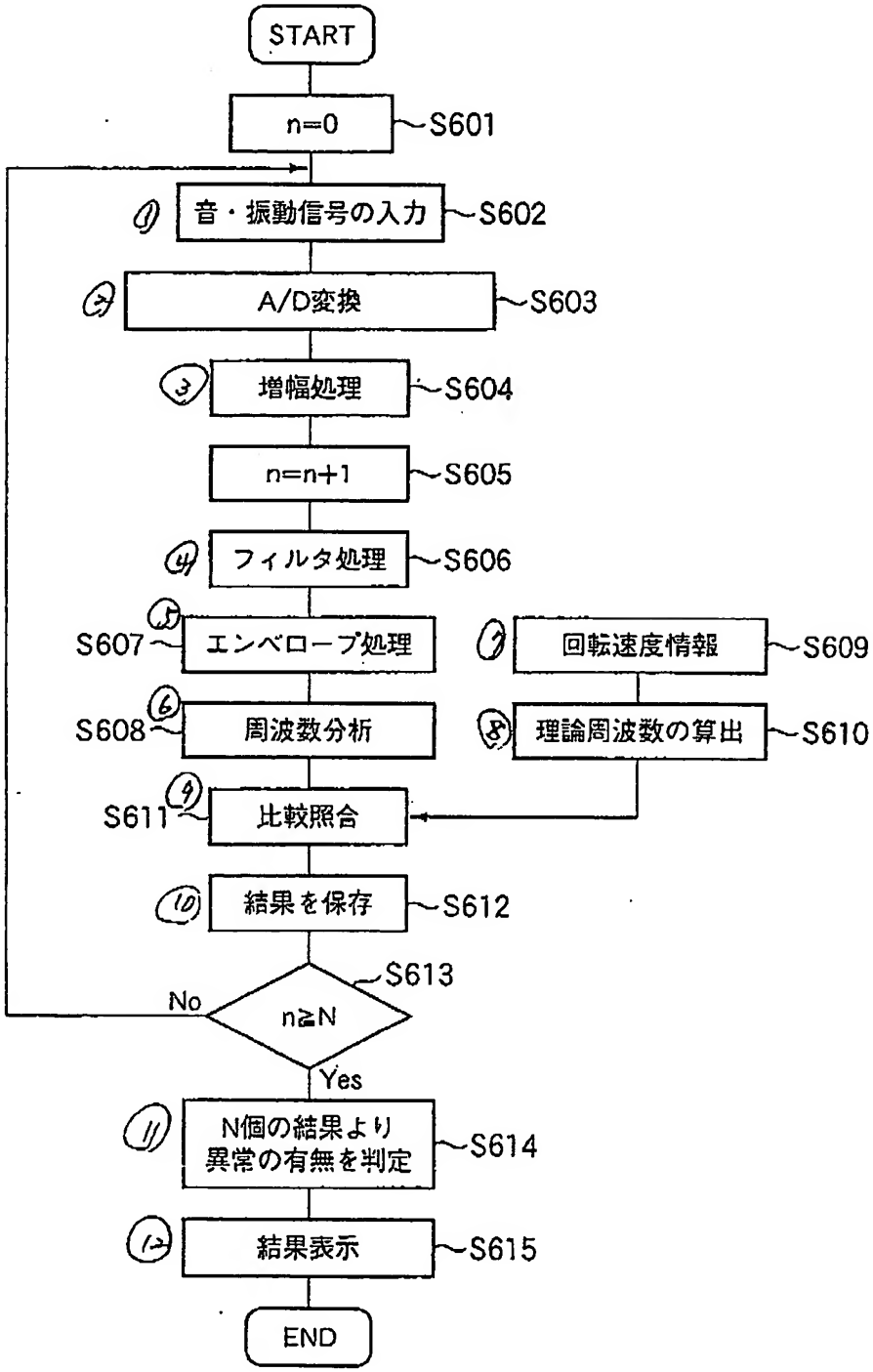

START
n=0
S601
① 音・振動信号の入力
S602
② A/D変換
S603
③ 増幅処理
S604
n=n+1
S605
④ フィルタ処理
S606
⑤ エンベロープ処理
S607
⑦ 回転速度情報
S609
⑥ 周波数分析
S608
⑧ 理論周波数の算出
S610
⑨ 比較照合
S611
⑩ 結果を保存
S612
S613
No
n≧N
Yes
⑪ N個の結果より異常の有無を判定
S614
⑫ 結果表示
S615
END

図41 Fig.41

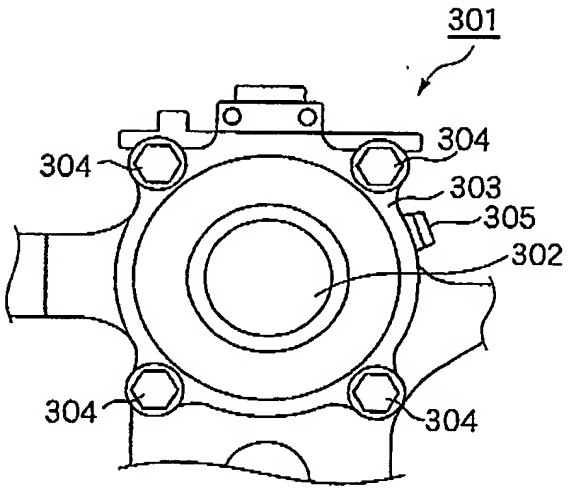


図42 Fig. 42

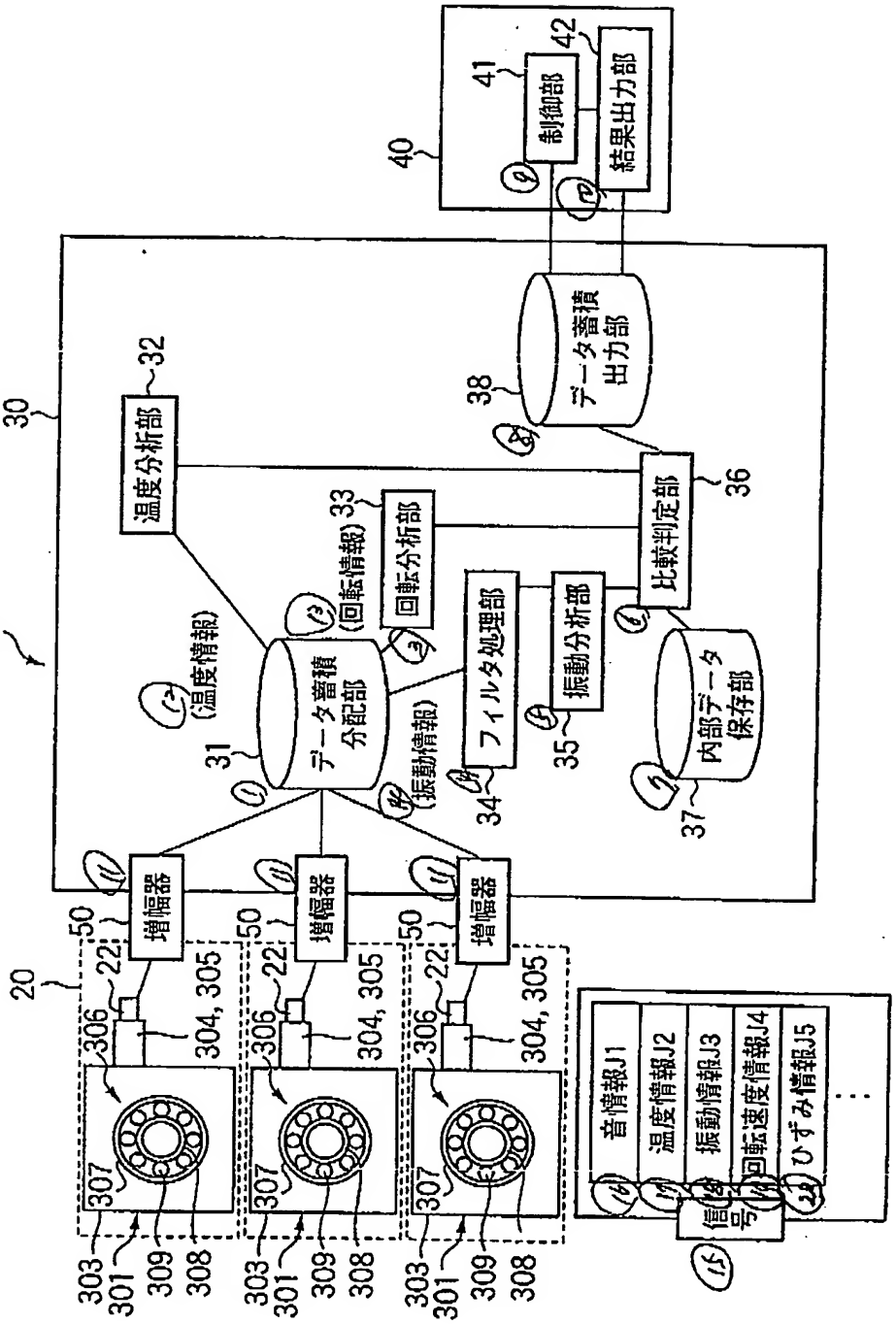

310
30
温度分析部
32
データ蓄積分配部
31
(温度情報)
(振動情報)
回転分析部
33
(回転情報)
フィルタ処理部
34
振動分析部
35
比較判定部
36
内部データ保存部
37
データ蓄積出力部
38
40
制御部
41
結果出力部
42
増幅器
50
22
20
306
304, 305
307
303
301
309
308
音情報J1
温度情報J2
振動情報J3
回転速度情報J4
ひずみ情報J5
信号

図43 Fig. 43

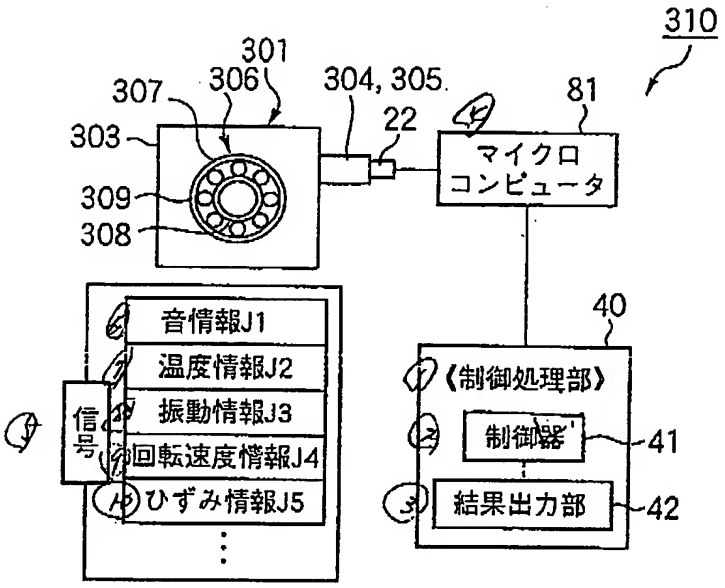


図44 Fig. 44

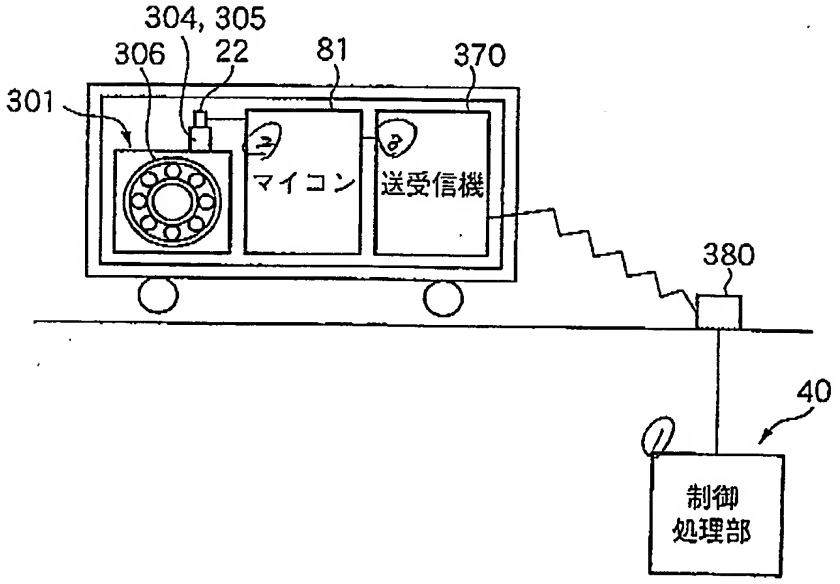


図45 Fig. 45

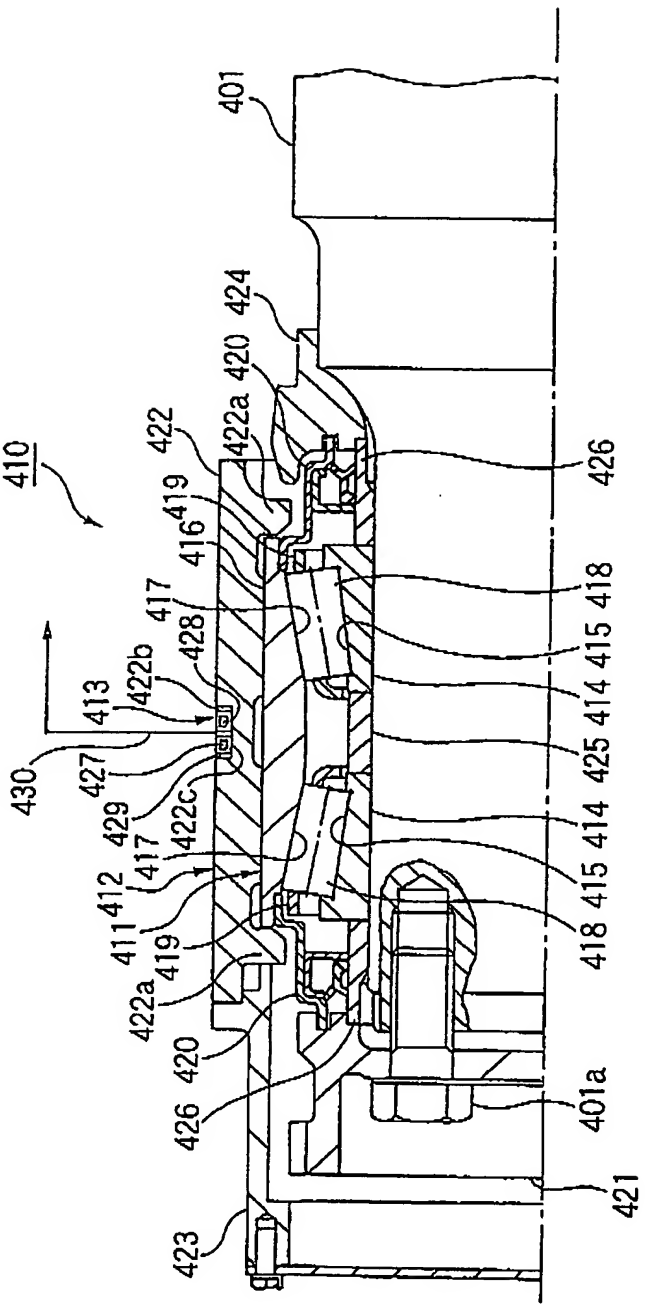

401
424
420
422a
422
426
410
419
416
417
418
428
415
422b
414
413
425
430
427
429
422c
414
417
415
412
418
411
419
422a
420
426
401a
421
423

図46 Fig. 46

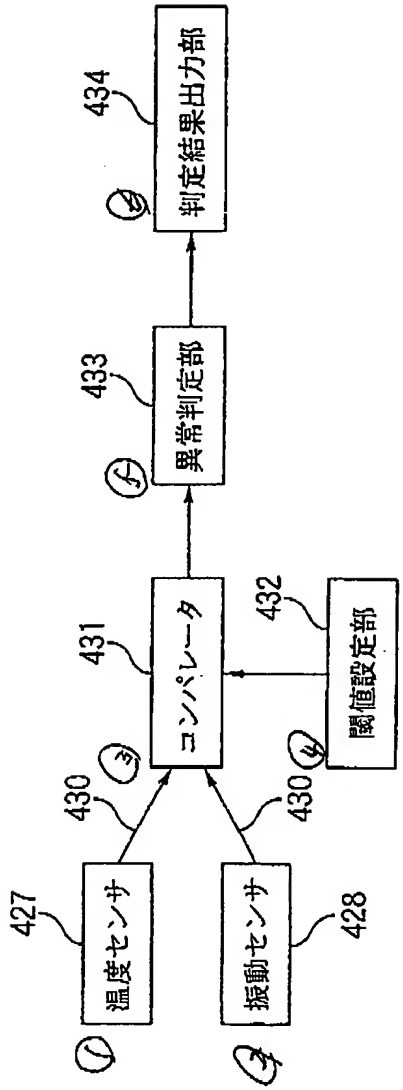

判定結果出力部
434
異常判定部
433
コンパレータ
431
閾値設定部
432
温度センサ
427
振動センサ
428
430
430
①
②
③
④
⑤
⑥

図47 Fig. 47

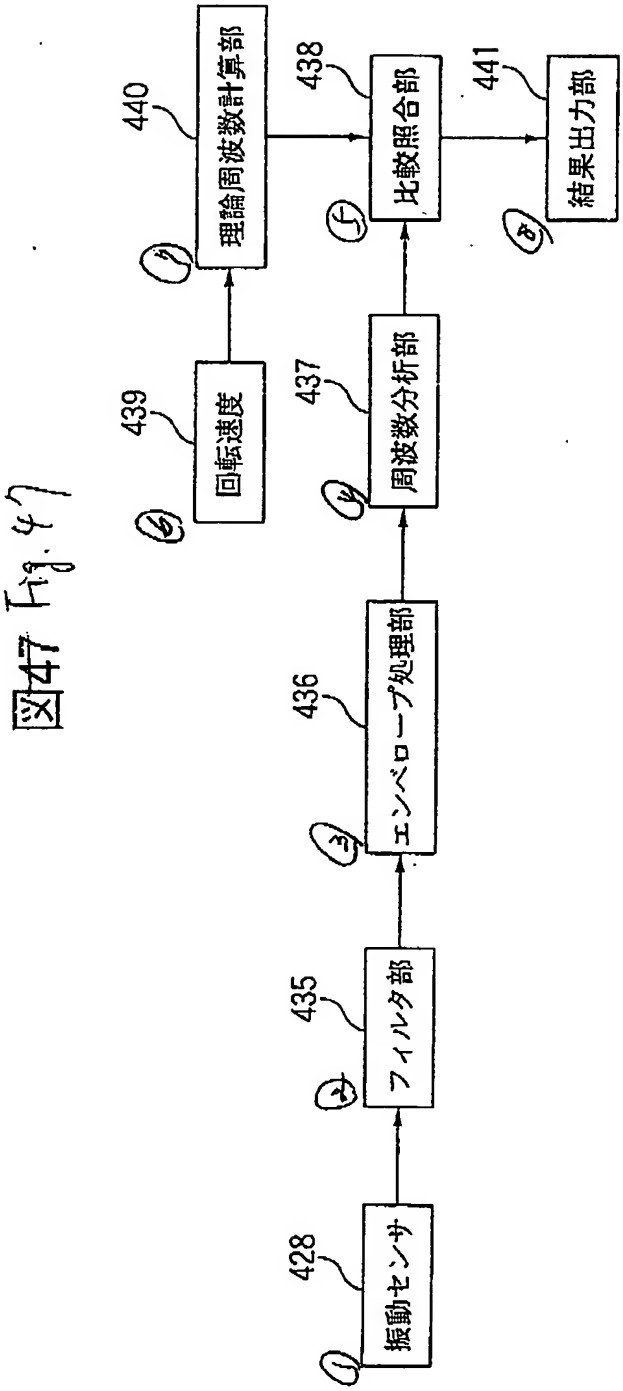

振動センサ
428
フィルタ部
435
エンベロープ処理部
436
周波数分析部
437
回転速度
439
理論周波数計算部
440
比較照合部
438
結果出力部
441

図48 Fig. 48

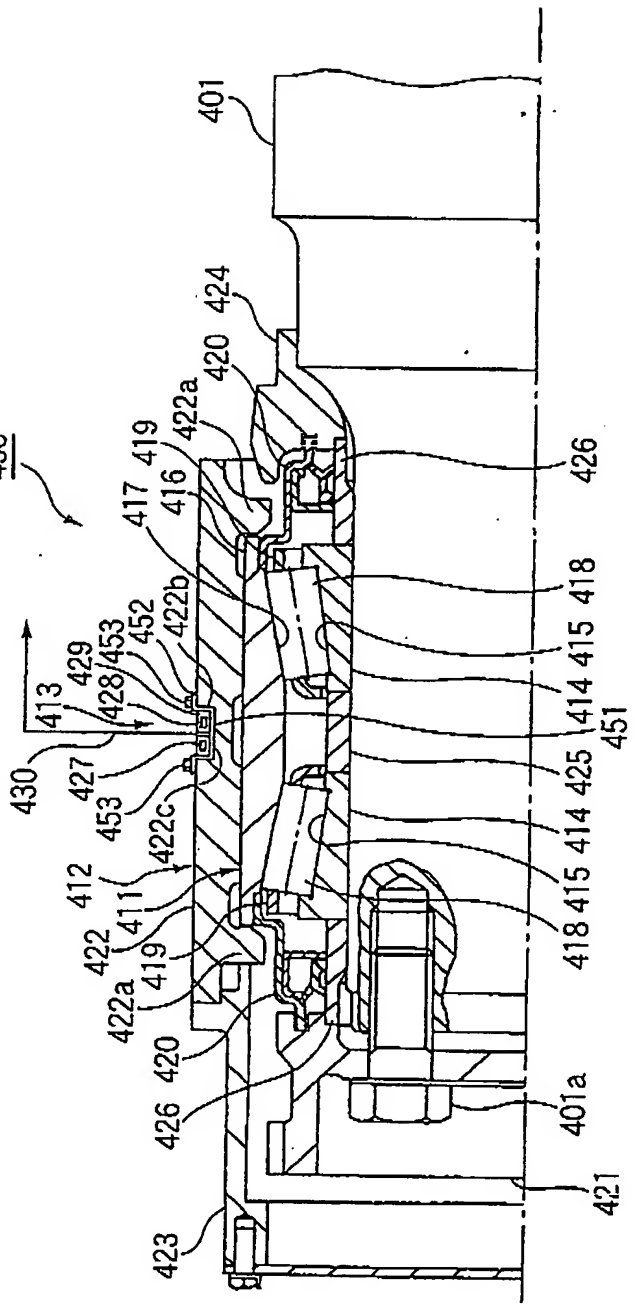

401
424
420
422a
419
417
416
450
426
418
422b
452
453
429
428
413
415
414
451
430
427
425
453
422c
414
412
415
411
418
422
419
422a
420
426
401a
421
423

図49 Fig 49

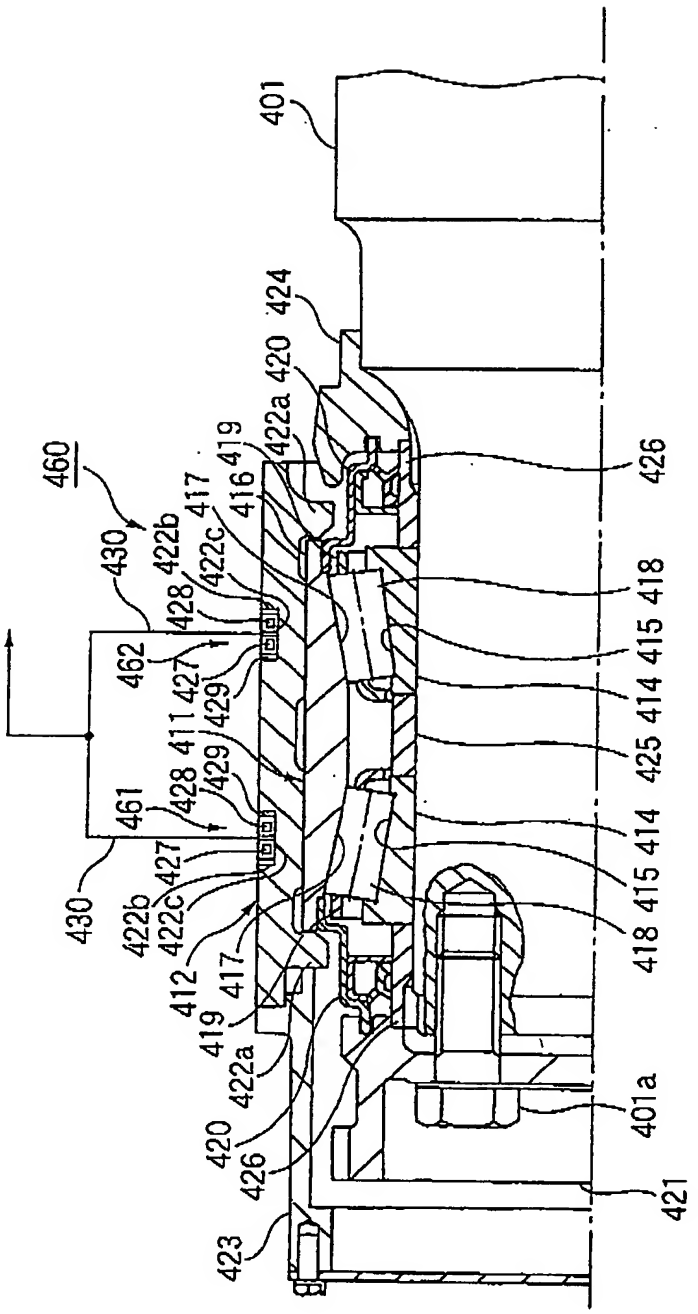

401
424
420
422a
419
416
417
422c
422b
430
460
428
462
427
429
411
461
412
426
418
415
414
425
401a
421
423

図50 Fig. 50

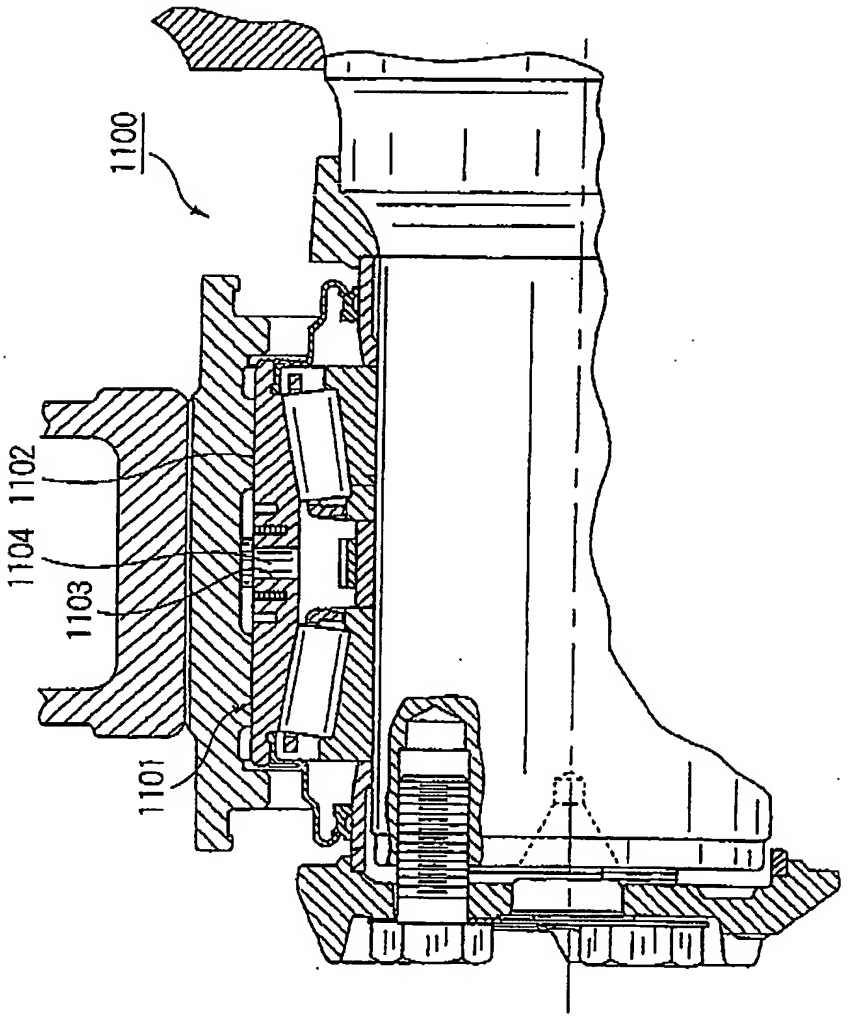
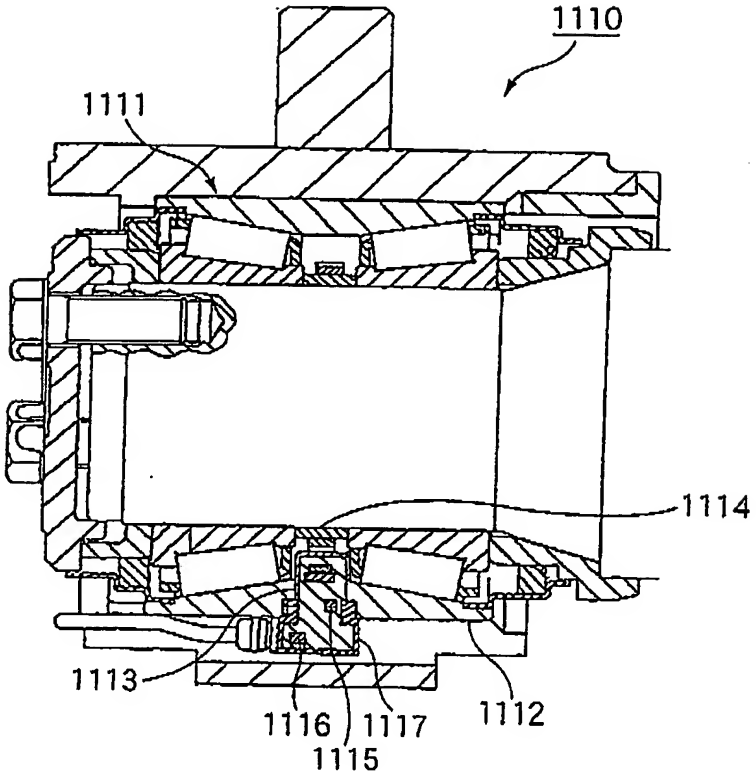


図51 Fig. 51



図~~52~~ Fig. 52

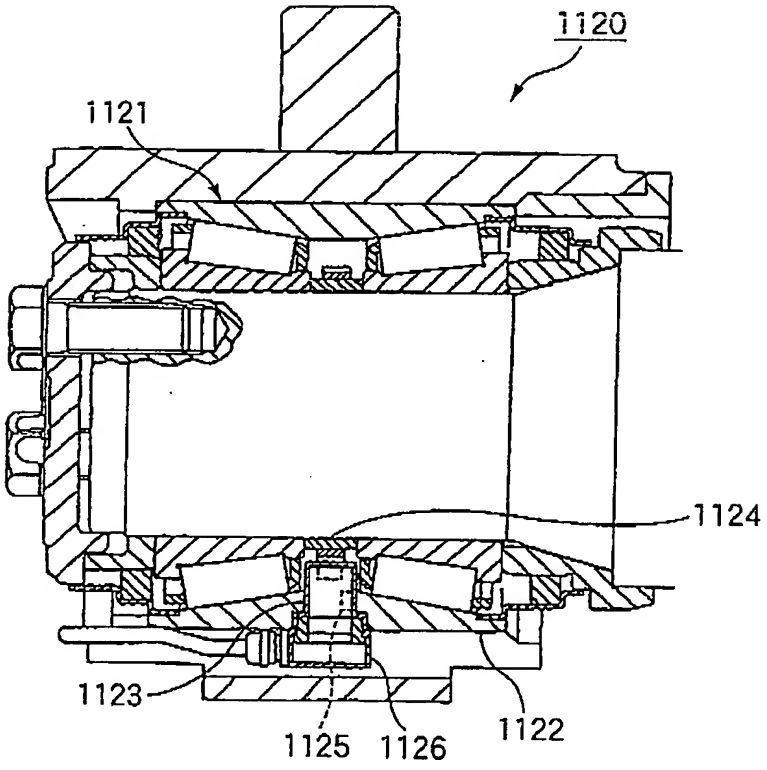


図53 Fig. 53

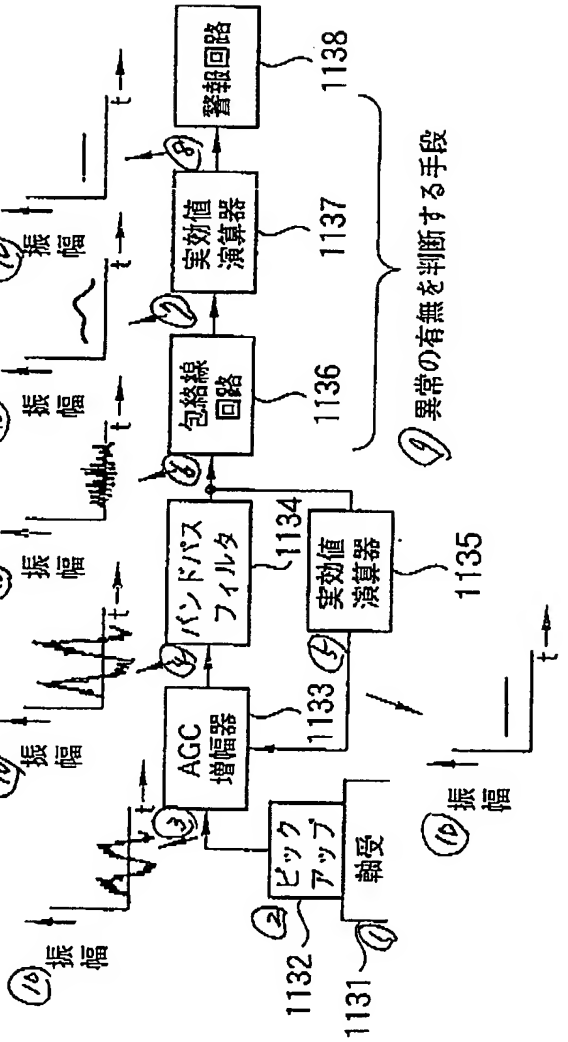

1130
振幅
t
AGC 増幅器
バンドパス フィルタ
包絡線 回路
実効値 演算器
警報回路
ピック アップ
軸受
実効値 演算器
1131
1132
1133
1134
1135
1136
1137
1138
異常の有無を判断する手段

図54 Fig. 54

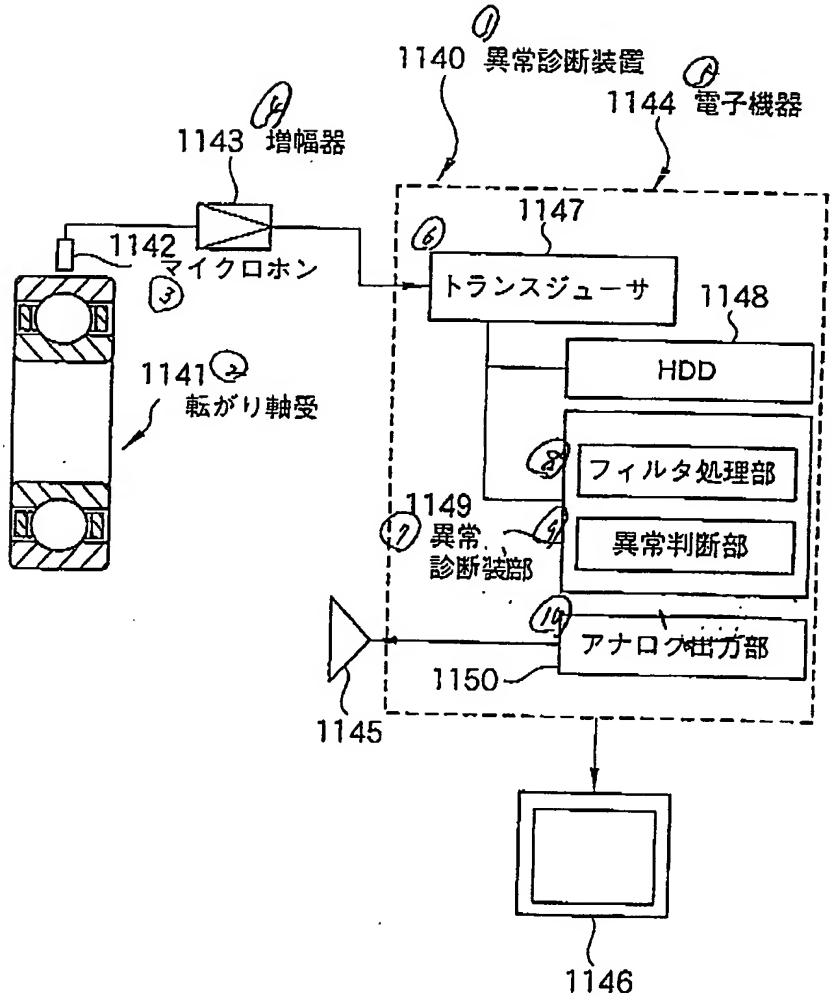
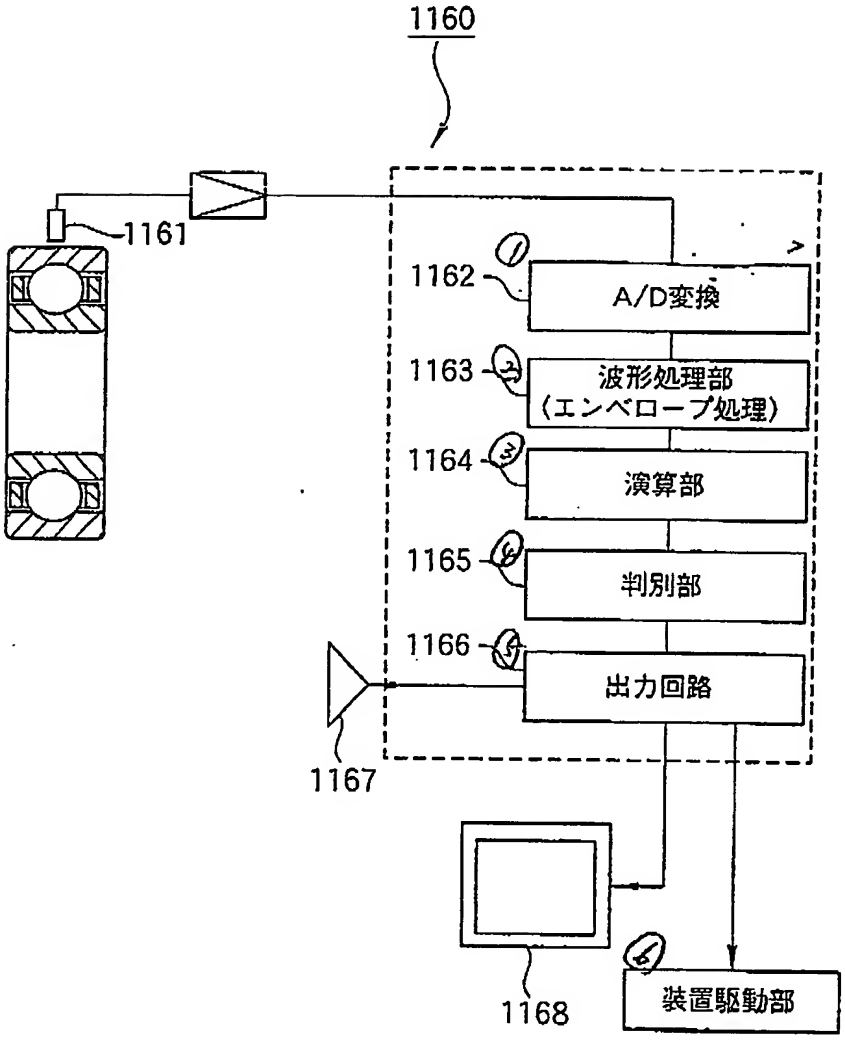

1
1140 異常診断装置
8
1144 電子機器
4
1143 増幅器
1147
6
1142
マイクロホン
3
トランスジューサ
1148
HDD
1141
2
転がり軸受
8
フィルタ処理部
1149
7
異常
診断装部
9
異常判断部
10
アナログ出力部
1150
1145
1146

図55 Fig.55


1160
1161
1162
A/D変換
1163
波形処理部
(エンベロープ処理)
1164
演算部
1165
判別部
1166
出力回路
1167
1168
装置駆動部

FIGS.1, 42:

(1) data accumulating/distributing portion 31

(2) temperature analyzing portion 32

(3) rotation analyzing portion 33

(4) filtering processing portion 34

(5) vibration analyzing portion 35

(6) comparing/deciding portion 36

(7) internal data saving portion 37

(8) data accumulating/outputting portion 38

(9) controlling portion 41

(10) result outputting portion 42

(11) amplifier 50

(12) (temperature information)

(13) (rotation information)

(14) (vibration information)

(15) signals

(16) sound information J1

(17) temperature information J2

(18) vibration information J3

(19) rotation speed information J4

(20) distortion information J5

FIG.2(a):

(1) temperature sensing element 22b

(2) rotation sensing element 22c

(3) vibration sensing element 22d

(4) To a calculating/processing portion 30

FIG.2(b):

(1) temperature sensing element 22b

(2) rotation sensing element 22c

(3) vibration sensing element 22d

(4) amplifier 22e

(5) amplifier 22f

(6) amplifier 22g

(7) To a calculating/processing portion 30

FIG.3:

(1) data accumulating portion 31a

(2) sampling reference setting portion 31b

(3) sampling portion 31c

(4) inputting portion 100

(5) To a temperature analyzing portion 32

(6) To a rotation analyzing portion 33

(7) To a filtering processing portion 34

FIG.4:

(1) flaw of a rolling bearing

(2) frequency after an enveloping process

(3) inner ring (Si)

(4) outer ring (So)

(5) rolling element (Sb)

(6) retainer (Sc)

(7) fr: inner ring rotation speed [Hz]

(8) fc: retainer rotation speed [Hz]

(9) fb: rolling element rotation speed [Hz]

(10) dm: pitch circle diameter [mm]

(11) Z: number of rolling elements

(12) Da: rolling element diameter [mm]

(13) α : contact angle [degree]

FIG.5:

(1) loading range A1

(2) non-loading range A2

FIG.6:

(1) time-variant waveform

FIG.7:

(1) FFT spectrum

FIG.8:

(1) envelope FFT spectrum

(2) frequency component due to damage of the outer ring of the bearing

FIG.9:

(1) sense sound/vibration signals (S101)

(2) A/D conversion (S102)

(3) save in a predetermined format (S103)

(4) frequency analysis (S104)

(5) select a filter bandwidth (S105)

(6) filtering process (S106)

(7) enveloping process (S107)

(8) frequency analysis (S108)

(9) calculate a RMS value (S109)

(10) calculate a frequency due to abnormality of the bearing (S110)

(11) extract an inner ring flaw component Si (Zfi), an outer ring flaw component So (Zfc), a rolling element flaw component Sb (2fb), and a retainer component Sc (fc) (S111)

(12) calculate a reference value (S112)

(13) Si, So, Sb, Sc > reference value (S113)

(14) No abnormality is generated in the bearing (S114)

(15) identify the abnormal position Si(inner ring flaw), So (outer ring flaw), Sb (rolling element flaw), Sc (retainer flaw) (S115)

FIGS.10, 11, 12:

(1) reference value

FIG.13:

(1) sense sound/vibration signals (S101)

(2) A/D conversion (S102)

(3) forming into a digital file (S103)

(4) frequency analysis (S104)

(5) select a filter bandwidth (S105)

(6) filtering process (S106)

(7) enveloping process (S107)

(8) frequency analysis (S108)

(9) calculate a peak value (S201)

(10) calculate a frequency due to abnormality of the bearing (S202)

(11) extract an inner ring flaw component Si (Zfi), an outer ring flaw component So (Zfc), a rolling element flaw component Sb (2fb), and a retainer

component Sc (fc) (S203)

(12) Do Si, So, Sb, Sc have a peak value ? (S204)

(13) No abnormality is generated in the bearing (S205)

(14) identify the abnormal position Si(inner ring flaw), So (outer ring flaw), Sb (rolling element flaw), Sc (retainer flaw) (S206)

FIG.14:

(1) $\delta_1(=Y_1-Y_0)>0$ -①

$\delta_2(=Y_2-Y_1)<0$ -②

where A (X_0,Y_0), B (X_1,Y_1), C (X_2,Y_2).

When ①, ② are satisfied and

$dy/dx=(Y_1-Y_0)/(X_1-X_0)>1$

or

$dy/dx=(Y_2-Y_1)/(X_2-X_1)<-1$

is satisfied, Y_1 is decided as a peak.

FIG.15:

(1) Do the primary components coincide with each other ? (S201)

(2) Do the secondary components coincide with each other ? (S202)

(3) Do the secondary components coincide with each other ? (S211)

(4) Do the quaternary components coincide with each other ? (S212)

(5) No abnormality is generated (S321)

(6) The abnormality is generated (S321)

FIG.16:

(1) collate only the primary, secondary, quaternary components (flaw of the outer ring)

(2) (secondary)

(3) (quaternary)

FIG.17:

(1) reference level L_0 (RMS value f1)

(2) level difference

FIG.18:

(1) a relationship between a size of flaking and a level difference

(2) reference level dB

(3) size of flaking mm

FIG.19:

(1) calculate the abnormal frequency due to the abnormality in the bearing (S401)

(2) extract a primary component due to the inner ring flaw, a primary component due to the outer ring flaw, a primary component due to the rolling element flaw, and a primary component due to the retainer (S402)

(3) extract a natural-number multiple component due to the inner ring flaw, a natural-number multiple component due to the outer ring flaw, a natural-number multiple component due to the rolling element flaw, and a natural-number multiple component due to the retainer (S403)

(4) comparing the primary component with respective natural- number multiple components by referring to reference value (S404)

(5) Is the abnormality generated ? (S405)

(6) The abnormality is generated. Identify the abnormal position (S406)

(7) No abnormality is generated (S407)

FIG.20:

(1) degree

(2) level (dB)

(3) criterion line

(4) roller missing sound

(5) The case where the flaw is generated

FIG.21:

(1) calculate the abnormal frequency due to the abnormality in the bearing (S501)

(2) calculate V_i and V_{RMS} (S502)

(3) calculate a difference between V_i, V_{RMS} or a quotient (S503)

(4) Does the difference or the quotient exceed a reference value ? (S504)

(5) The abnormality is generated. Identify the abnormality occurring location (S505)

(6) No abnormality is generated (S506)

FIGS.22, 23, 24, 25:

(1) frequency Hz

(2) intensity

FIG.26:

(1) temperature sensing element 52b

(2) rotation sensing element 52c

(3) vibration sensing element 52d

(4) transmitting portion 52h

(5) To the calculating/processing portion 30

FIG.27:

(1) data accumulating portion 31

(2) temperature analyzing portion

(3) rotation analyzing portion

(4) filtering processing portion 34

(5) vibration analyzing portion

(6) comparing/deciding portion 36

(7) internal data saving portion 37

(8) data accumulating/outputting portion 38

(9) controlling portion 41

(10) result outputting portion 42

(11) receiving portion 60

(12) (temperature information)

(13) (rotation information)

(14) (vibration information)

(15) radio communication

(16) signals

(17) sound information J1

(18) temperature information J2

(19) vibration information J3

(20) rotation speed information J4

(21) distortion information J5

FIG.28:

(1) (sensor built-in bearing) 21

(2) <calculating/processing portion> 30

(3) data accumulating/distributing portion 31

(4) temperature analyzing portion 32

(5) rotation analyzing portion 33

(6) filtering processing portion 34

(7) vibration analyzing portion 35

(8) comparing/deciding portion 36

(9) internal data saving portion 37

(10) data accumulating/outputting portion 38

(11) <controlling/processing portion> 40

(12) controller 41

(13) result outputting portion 42

(14) signal transmitting/receiving device 63

(15) information processing center

(16) (temperature information)

(17) (rotation information)

(18) (vibration information)

(19) signals

(20) sound information J1

(21) temperature information J2

(22) vibration information J3

(23) rotation speed information J4

(24) distortion information J5

(25) feedback

FIG.29:

(1) (sensor built-in bearing) 21

(2) data accumulating/distributing portion 31

(3) temperature analyzing portion 32

(4) rotation analyzing portion 33

(5) filtering processing portion 34

(6) vibration analyzing portion 35

(7) comparing/deciding portion 36

(8) internal data saving portion 37

(9) data accumulating/outputting portion 38

(10) result outputting portion 42

(11) <calculating/processing portion> 73

(12) <controlling/processing portion> 75

(13) (temperature information)

(14) (rotation information)

(15) (vibration information)

(16) signals

(17) sound information J1

(18) temperature information J2

(19) vibration information J3

(20) rotation speed information J4

(21) distortion information J5

(22) remove and bring it to the calculating/processing portion

FIG.30:

(1) <controlling/processing portion> 40

(2) controller 41

(3) result outputting portion 42

(4) <microcomputer> IC chip memory 81

(5) machinery facility 90

(6) <sensing processing portion>

(7) signals

(8) sound information J1

(9) temperature information J2

(10) vibration information J3

(11) rotation speed information J4

(12) distortion information J5

FIG.31:

(1) data accumulating/distributing portion 31

(2) temperature analyzing portion 32

(3) rotation analyzing portion 33

(4) filtering processing portion 34

(5) vibration analyzing portion 35

(6) comparing/deciding portion 36

(7) internal data saving portion 37

(8) <microcomputer> 81

(9) (temperature information)

(10) (rotation information)

(11) (vibration information)

FIGS.32, 33:

(1) <controlling/processing portion> 40

(2) controller 41

(3) result outputting portion 42

(4) <microcomputer> IC chip memory 81

(5) machinery facility 90

(6) signals

(7) sound information J1

(8) temperature information J2

(9) vibration information J3

(10) rotation speed information J4

(11) distortion information J5

FIG.34(a):

(1) piezoelectric sensor signal

(2) temperature data input

(3) rotating pulse input

FIG.35(a):

(1) temperature sensor 163

(2) sensing circuit

(3) impact sensor 183

(4) amplifier filter 184

(5) rotating pulse input

FIG.36:

(1) machinery facility monitoring system 191

(2) peripheral function

(3) sensor signal output

(4) diagnosed feature parameter output diagnosis result output

FIG.38:

(1) <controlling/processing portion> 40

(2) controller 41

(3) result outputting portion 42

(4) <sensing processing portion>

(5) <microcomputer> IC chip memory 250

(6) signals

(7) sound information J1

(8) temperature information J2

(9) vibration information J3

(10) rotation speed information J4

(11) distortion information J5

FIG.39:

(1) data accumulating/distributing portion 31

(2) temperature analyzing portion 32

(3) rotation analyzing portion 33

(4) filtering processing portion 34

(5) vibration analyzing portion 35

(6) internal data saving portion 37

(7) <calculating/processing portion> 250

(8) comparing/deciding portion 252

(9) (temperature information)

(10) (rotation information)

(11) (vibration information)

FIG.40:

(1) input sound/vibration signals (S602)

(2) A/D conversion (S603)

(3) amplifying process (S604)

(4) filtering process (S606)

(5) enveloping process (S607)

(6) frequency analysis (S608)

(7) rotation speed information (S609)

(8) calculate a theoretical frequency (S610)

(9) compare/collate (S611)

(10) save the result (S612)

(11) decide based on N results whether or not the abnormal is present (S614)

(12) display the result (S615)

FIG.43:

(1) <controlling/processing portion> 40

(2) controller 41

(3) result outputting portion 42

(4) microcomputer 81

(5) signals

(6) sound information J1

(7) temperature information J2

(8) vibration information J3

(9) rotation speed information J4

(10) distortion information J5

FIG.44:

(1) controlling/processing portion 40

(2) microcomputer 81

(3) transmitter/receiver 370

FIG.46:

(1) temperature sensor 427

(2) vibration sensor 428

(3) comparator 431

(4) threshold setting portion 432

(5) abnormality deciding portion 433

(6) decision result outputting portion 434

FIG.47:

(1) vibration sensor 428

(2) filter portion 435

(3) envelope proccssing portion 436

(4) frequency analyzing portion 437

(5) comparing/collating portion 438

(6) rotation speed 439

(7) theoretical frequency calculating portion 440

(8) result outputting portion 441

FIG.53:

(1) bearing 1131

(2) pickup 1132

(3) AGC amplifier 1133

(4) band-pass filter 1134

(5) RMS calculator 1135

(6) envelope circuit 1136

(7) RMS calculator 1137

(8) alarm circuit 1138

(9) means for deciding whether or not the abnormality is present

(10) amplitude

FIG.54:

(1) abnormality diagnosis system 1140

(2) rolling bearing 1141

(3) microphone 1142

(4) amplifier 1143

(5) electronic device 1144

(6) transducer 1147

(7) abnormality diagnosing portion 1149

(8) filtering processing portion

(9) abnormality deciding portion

(10) analog outputting portion 1150

FIG.55:

(1) A/D conversion 1162

(2) waveform processing portion (enveloping process) 1163

(3) calculating portion 1164

(4) deciding portion 1165

(5) outputting portion 1166

(6) system driving portion